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ABSTRACT

This document reports the outcomes of a research project which investigated the effects of bilingualism on vocational concept formation. It focuses more on the broad application of the research than on the technical presentation and analysis of the data. The report is divided into five principal chapters: (1) bilingualism and vocational education, (2) a review of concept learning, (3) procedures used in the study, (4) presentation of the findings, and (5) application of the study. Chapter 1 includes a discussion concerning education and the Mexican-American community in Texas. Chapter 2 discusses such topics as concept learning in the classroom and variables affecting concept learning (learner and learning situation characteristics). Teaching concept formats are presented in chapter 3, such as lesson plans, development of instructional materials, tests, and translation of materials from English to Spanish. Chapter 4, results of the study, includes data tables and explanations of sub-studies within the main project. The application and implications of the data presented in chapter 4 are discussed in chapter 5. A list of references and vocabulary words are included in the report along with appended materials used in the study: visuals, test instruments, and scripts for instructional materials (English and Spanish versions). (CT)

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BILINGUALISM AND VOCATIONAL CONCEPT LEARNING

Final Report of Project Number G007604053

A Study of the Acquisition of Vocational
Concepts by Bilingual Students in
Vocational Education Programs

Funded by the Bureau of Occupational and Adult Education,
U.S. Office of Education

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The research reported here was performed under contract with the U.S. Office of Education. Contractors undertaking such projects are encouraged to express freely their professional judgment in the conduct of such projects. Points of view or opinions stated do not, therefore, necessarily represent U.S. Office of Education official position or policy.

June, 1977

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
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FOREWARD

Vocational education, it is said, is for everyone who can profit by it and who desires to participate. This generous expression of accessibility appears in virtually all federal legislation dealing with vocational education and is repeatedly emphasized before legislative sub-committees, state conventions, and open house gatherings. Although efforts to make vocational education available to all who desire to participate may appear to be relatively successful, a close examination reveals that certain groups have failed to share equally in the benefits of vocational education. The limited English-speaking, for example, have often exited vocational programs with fewer skills than their peers (Salazar, 1976). For this reason, the special needs of limited English-speaking persons have been singled out by recent federal legislation as a priority for research, personnel development and program innovation.

This publication reports the outcomes of a research project which investigated the effects of bilingualism on vocational concept formation. The project was selected for funding by the United States Office of Education (USOE) on the basis of its potential application to the improvement of instruction for limited English-speaking vocational students. The authors of the report realize that vocational teachers and administrative personnel are being called upon to address the needs of many special interest groups, in addition to the limited English-speaking. For the reason, the report focuses more on the broad application of the research than on the technical presentation and analysis of the data.

The report is divided into five principal chapters:

1. Bilingualism and Vocational Education
2. A Review of Concept Learning
3. Procedures Used in the Study
4. Presentation of the Findings
5. Application of the Study

A very definite commitment has been made by vocational leaders at the national level to assist limited English-speaking persons to derive maximum benefit from vocational education. The outcomes of this study and related studies are intended to identify the strategies that will assist vocational educators to fulfill their commitment to this important group of citizens.

An 11 page mini-report has been prepared as a companion volume to this final report. The mini-report summarizes the strategies that can be used to improve vocational instruction for persons with limited English-speaking ability. A copy of the mini-report is appended to this report. Additional copies maybe obtained while the supply lasts by requesting them from the Center for Career Development and Occupational Preparation, College of Education, Texas A&M University, College Station, Texas 77843.

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Terms Used in the Report

To facilitate the communication of ideas in this study, key words and phrases have been singled out for clarification.

Bilingual Education is the concurrent use of two languages as the media for instruction in any portion of the school curriculum except in the actual study of the languages themselves (Salazar, 1976).

Bilingual Vocational Education means training or retraining which is conducted as part of a program designed to prepare individuals of limited English-speaking ability for gainful employment as semi-skilled or skilled workers or technicians or subprofessionals in recognized occupations and in new and emerging occupations . . . bilingual vocational training includes guidance and counseling (either individually or through group instruction) in connection with such training or for the purpose of facilitating occupational choices; instruction related to the occupations for which the students are in training or instruction necessary for students to benefit from such training; the training of persons engaged in a bilingual vocational program; travel of students and vocational training personnel while engaged in a bilingual vocational training program; and the acquisition, maintenance, and repair of instructional supplies, aids, and equipment, but such term does not include the construction, acquisition, or initial equipment of buildings or the acquisition or rental of land (Federal Register, Vol 65, p.8955)

Disadvantaged, as defined by the U.S. Office of Education, means persons, not otherwise handicapped, who have academic, socioeconomic, cultural, or other handicaps that prevent them from succeeding in vocational education (Federal Register, Vol 59, p.54).

English As A Second Language (ESL) is a program designed to teach English language skills without the presentation of related cultural material. It is taught for only a limited number of hours each week, with English presented to Spanish-speaking students in much the same way that a foreign language is taught to English-speaking students. The objective is to make non-English speakers competent in English and, by this means, to enable them to become assimilated into the dominant culture. ESL, a purely linguistic technique, is not a cultural program and therefore, does not take into consideration the specific educational needs of Spanish-speaking students as a unique ethnic group (Federal Register, Vol 61, p.26).

Special Needs Students: The Publication Committee of the American Vocational Association (1976) has tentatively defined special needs students as "those persons who meet the criteria as handicapped or disadvantaged persons who require special programs, modification of programs, or supplmental services to help them succeed in a vocational education program" (p.43).

Concept: Numerous scholars have attempted to define what a concept is. The lack of a universally acknowledged definition of the term makes it difficult to ascertain whether the various people who purport to be studying concept formation are actually studying the same phenomenon. For purposes of this study, Klausmeier and Ripple's (1971) definition of concept will be used: A concept is a mental construct, or abstraction, characterized by psychological meaningfulness, structure, and transferability that enables an individual to do the following: (1) cognize things and events as belonging to the same class and as different from things and events belonging to other classes; (2) cognize other related super-ordinate, coordinate, and subordinate concepts in a hierarchy; (3) acquire principles and solve problems involving the concept; (4) learn other concepts of the same difficulty level in less time (p. 402).

Concept Formation: According to Clark (1975), concept formation is the ability to correctly:"(1) identify the critical, semicritical and noncritical properties of a concept; (2) sort out or identify new instances and discriminators of a concept that are presented by the teacher; and (3) find new instances of the concept without help from the teacher"(p. 58).

Positive Instance: A stimulus item which exhibits all the critical properties of a concept in their appropriate relationship is a positive instance. This term is used interchangeably in the literature with the terms "example" and "exemplar."

Negative Instance: A unit which according to Clark (1971) either contains or displays "(a) none or some but not all of the critical properties of a concept in their appropriate or inappropriate relationship, or (b) all the critical properties of a concept but in an inappropriate relationship" (p. 261).

Irrelevant Attribute: A property of any particular example which according to Markle and Tiemann (1969) can be varied without changing the example to a nonexample.

Relevant Attribute: Relevant attributes are those characteristics which according to Woolley and Tennyson (1972) are essential to the item for it to be classified as belonging to the concept. This term is used interchangeably in the literature with the terms "essential characteristic" and "critical property".

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CHAPTER 1

BILINGUALISM AND VOCATIONAL EDUCATION

In recent years, public education has been repeatedly confronted by the demands of special interest groups. Many of the demands made by these groups have been upheld by court rulings or enacted into law by legislative bodies. Thus, each year more groups demand more of education.

Although a certain amount of backlash has been expressed over superimposed regulation of public education, most state and local education agencies are forced to comply with "outside" regulations because of the dependence they have developed for financial assistance from sources other than local revenues. At the same time that increased government regulations are being imposed concerning special groups, critics from both within and outside education are expressing definite concerns about the quality of general education. Drop out rates in many school districts have reached alarming proportions. Educational achievement levels have dropped off in many places, including relatively affluent school districts. Crime in the schools has become a problem of national significance.

In terms of priorities to be addressed, public education is truly stymied. On the one hand are increased demands for programs and services; on the other is a rapidly mounting dissatisfaction with general education. It is within this rather volatile and sensitive educational climate that one must approach the issue of bilingualism and the education of the limited English-speaking. One could easily join the ranks of those who vociferously chide public education for what appears to them to be complacency toward the educational problems of limited English-speaking persons. But the issue is much too complex to resolve without a thorough review. Furthermore, the resolution of the problem may require more than educational intervention alone.

The National Vocational Education Commitment

Recent vocational education legislation (P.L. 94-482, Title II) speaks repeatedly to the issue of the limited English-speaking. First, the act requires state advisory councils to have representation from school systems with large concentrations of persons who have special academic, social, economic, and cultural needs and persons "who have limited English-speaking ability" (*Federal Register,* Vol. 42, No. 67). Next the act requires annual and five year state plans for vocational education to "set forth as precisely as possible the intended use of Federal funds . . . to meet the special needs of . . . persons of limited English-speaking ability" (*Federal Register*, Vol. 42, No. 67). By including the limited English-speaking among the groups classified as disadvantaged, the Act makes it possible to use the 20% set-aside monies for the disadvantaged to address the needs of the limited English-speaking. Further, the act lists programs and services for the limited English-speaking as a priority area for vocational education research and exemplary and innovative program development. Finally, the Act sets aside money for projects to "develop instructional materials and encourage research programs and demonstration programs to meet the critical shortage of instructional materials for bilingual vocational training programs" (*Federal Register*, Vol. 42, No. 67).

Federal vocational education legislation clearly speaks to the needs of the limited English-speaking as it does the needs of the handicapped, and the disadvantaged, and the issue of sex role stereotyping. Special interest groups most definitely are sharing in the benefits of federal vocational education funding. It is now up to local leaders of vocational education and special interest groups to avail themselves of the money that has been ear-marked for those who have special needs.

The Limited English-Speaking in a State and Local Context

The problem of bilingualism and the limited English-speaking cannot be addressed at the state and local level as easily as at the federal level. At the federal level, a commitment can be shown to an issue by enacting legislation and appropriating special funds. Usually, such legislative activity results in having a substantial amount of funding pumped into a limited number of innovative and exemplary projects. Then, the general public is told in effect: "Here is an exemplary model which solves the problem . . . go and do likewise . . . but replicate at your own expense." Unfortunately, when local revenues must cover the expense of special programs and services for persons of limited English-speaking ability, it becomes a very sensitive issue, one which many, perhaps the majority, of taxpayers feel can be solved adequately with an application of old-fashioned Yankee determism: "If you choose to live in United States, you had better learn to speak English."

At the local community level, there are very strong historical antecedents which influence the manner in which language related problems are addressed. It must be remembered that a very significant number of United States citizens are descendants of immigrants who were non-English-speaking. Many, therefore, regard the mastery of English as part of a proud heritage. Moreover, the failure to adopt English as one's predominant language is regarded by many as "un-American". To further complicate the issue, our nation has not been very tolerant of nationalistic ghettoes. Thus, regions which have high concentrations of non-English-speaking persons are not likely to have a broad base of support when seeking funds for the purpose of instituting bilingual, remedial programs.

Also at the local level, the general problem of cultural assimilation or acculturation cannot be regarded solely from an educational perspective. Geographical, economic, and social factors surround the issue. Where there have been large geographic concentrations of non-English-speaking persons, for example, English has tended to be adopted much less rapidly as a second language. In ghettoes of non-English-speaking persons, English often is not learned until second generation family members are inculcated into broader segments of society where they are forced to speak English. The greater the concentration of non-English-speaking persons, the longer it appears to take for English as a second language to be acquired. Thus, along the mexican border, along the border of Quebec, and in certain urban ghettoes, the inability to speak standard English has persisted much longer as a problem than in other regions, although other regions such as the Dakotas and Minnesota were settled by a majority of non-English-speaking persons.

In a state such as Texas where there has been a great diversity of languages and cultures, the problem of limited English-speaking ability persists almost exclusively among persons of Hispanic or spanish-speaking background. Because of geographic, social, and economic factors, however, the problem of bilingualism from an educational standpoint is greatly compounded. So many biases and prejudices become involved at the local level that the pros and cons of special programs and services for students of limited English-speaking ability are most difficlut to evaluate objectively.

This study was an attempt to investigate in an objective manner the influence of bilingualism on vocational concept learning. However, it was clearly evident to the project staff that research in the area of bilingualism is a highly sensitive community issue, which has numerous cultural ramifications and involves diverse opinions about the provisions that should be made to accommodate the limited English-speaking. All of the students who participated in this study had Spanish-speaking backgrounds. Thus, the outcomes of the study must be interpreted in light of the population represented in the study.

Education and the Mexican-American Community in Texas

In the State of Texas, there are more than 600,000 students for whom Spanish is the predominant language. Approximately 250,000 of these students can be classified as limited English-speaking (Gutierrez, 1975). Bullock (1972) notes that "the illiteracy rate among Spanish-speaking Texans is extremely high" (p. 100, 1973). Schulman, Williams, and Guerra (1973) as well as the U.S. Commission on Civil Rights estimate that up to one half of the Spanish-speaking students in Texas drop out of school prior to graduation. Bullock says they drop out at "an alarming rate."

To assist Spanish-speaking students to acquire a basic education, the State requires special bilingual programs for students in kindergarten through the end of the second grade. Thereafter, bilingual instruction is optional. Even in the primary grades, it is possible for teachers to receive bilingual certification or endorsement by attending summer workshops sponsored by the state education agency. Thus, it is possible that many "bilingual" classes may involve Spanish only in a token manner.

A study of the bilingual situation in Texas by the U.S. Commission on Civil Rights found that there exists in Texas "a systematic failure of the educational process, which not only ignores the educational needs of Spanish-speaking students, but suppresses their culture and stifles their hopes and ambitions" (p. 40, in Sotomayor).

The Problem of Educational Under-Achievement Many different factors have been cited in the literature to explain the educational underachievement of Mexican-American students. In the past, some investigators have attributed the underachievement of Mexican-American students to deficiencies in motivation and intelligence (Carter, 1970). More commonly, however, the lack of achievement by Mexican-American students has been attributed to the lack of appropriate role models and activities in the home (Salazar, 1976). Johnson (1970) cites several factors including: impoverished experiential backgrounds, inefficient learning styles and different value systems. Mercer (1972) says that Mexican-American youth frequently are labeled as slow learners because of a lack of acculturation and because of their use of nonstandard English. Others place the blame for the underachievement of Mexican-Americans on the schools. They emphasize the inappropriateness of textbooks and standardized curricula. Moreover, they claim that it is not enough just to offer bilingual training during the primary years and in adult basic education programs. With an almost militant determinism, they insist that "schools, rather than children, should change . . . schools should adopt a bilingual curriculum so that Spanish-speaking students may receive school instruction in their mother tongue with culturally relevant materials" (p. 22, Salazar). The underachievement of Mexican-American students is clearly a difficult issue, complicated by the fact that some Mexican-American students succeed admirably while many others, though given equal education opportunities, fail.

Bilingual Vocational Programs in Texas: The total number of vocational programs at the secondary level in Texas exceeds 15,000. Of this number, only three programs are officially listed as bilingual programs. But unlike bilingual programs at the elementary level, bilingual vocational programs are not remedial or compensatory in nature. Rather, these programs prepare bilingual secretaries.

The need for bilingual vocational programs in Texas was studied in depth by Dr. Auturo Salazar (1976). With assistance from the Research Coordinating Unit of the Division of Occupational Education and Technology (Texas Education Agency), Salazar conducted a statewide survey to determine the need for bilingual vocational programs to assist students of limited English-speaking ability.

Participating in the survey were bilingual program directors, vocational directors, vocational counselors, secondary counselors, and industrial representatives who served as advisory committee members for area vocational schools. Three types of responses were solicited. First, recipients of the questionnaire were instructed to respond to a series of statements by indicating agreement or disagreement with a particular statement on a 5 point Likert scale. Next, a 7 point semantic differential format was used to solicit reactions to a series of bipolar adjectives describing bilingual vocational education. Third, open-ended responses were solicited concerning the need for bilingual vocational programs.

Salazar found substantial positive agreement with such statements as:

1. Much confusion exists about the goals, content, and method of bilingual education.
2. Since English is the primary language of the state, the adjustment in Texas must necessarily be the learning of English by the Spanish-speaking group.
3. Beginning the kind of programs that are effective with the Spanish-speaking educationally disadvantaged will require more teachers, more teacher-training programs, and new materials.
4. Incorporating bilingual education into vocational education will require more money than school districts have.

Disagreement was the greatest for such statements as:

1. Existing vocational programs do not meet the needs of limited English-ability students and consequently contribute to their high dropout rate.
2. The main problem faced by teachers in a bilingual vocational program would be teaching the technical terms commonly used on-the-job.
3. Assume that you are being charged with the responsibility for making the final decision of implementing an additional vocational program in your school district. Further assume that enough funds are available; you would first implement a bilingual vocational program rather than one of the traditional non-bilingual vocational programs....

To further assess the need for bilingual vocational programs, Salazar solicited reactions to a series of bipolar adjectives. To do this, he constructed a semantic differential with a seven point scale on which the respondents could check their preference of adjectives which best described their "feelings" about bilingual vocational education. In a presentation of the data, Salazar summarized the mean weighted group response for each item. Most of the scores clustered toward the mid-point, but across the groups there were some significant differences in the responses of various groups. Figure 1 summarizes Salazar's data. Rather than report mean weights, as Salazar did, the table we have prepared only

Figure 1

Response to Bi Polar Adjectives Concerning
Bilingual Vocational Education
by Groups of Educators and
Industrial Representatives

Positive Reaction +	Classification of Respondent*					Negative Reaction -
	BD	VD	VC	SC	IR	
Important	+	-	-	+	-	Unimportant
Simple	-	-	-	-	-	Complicated
Good	+	+	-	+	+	Bad
Successful	-	-	-	-	-	Unsuccessful
Effective	+	+	+	+	-	Ineffective
Valuable	+	+	+	+	+	Worthless
Strong	+	+	-	+	-	Weak
Useful	+	+	+	+	+	Useless
Help	+	+	+	+	+	Hinder
Satisfying	+	-	-	+	-	Unsatisfying
Efficient	+	-	-	-	-	Inefficient
True	+	+	+	+	-	False
Necessary	+	+	+	+	-	Unnecessary
Rewarding	+	+	+	+	+	Unrewarding
Productive	+	-	+	+	+	Unproductive

* BD - Bilingual Director
VD - Vocational Director
SC - Secondary Counselor
IR - Institutional Representative
VC - Vocational Counselor

indicates whether a particular group reacted positively or negatively to a particular adjective (i.e. ranked items either above or below a mean of 3.5). An analysis of the table shows that bilingual directors had the greatest number of positive responses to the bipolar adjectives and industrial representatives had the greatest number of negative responses. Only two negative responses were expressed by the bilingual directors while 9 negative responses were expressed by the industrial representatives, 6 by the vocational directors, 6 by the vocational counselors, and 3 by the secondary counselors.

In the table it can be seen that means for all groups were positive for such descriptors as valuable, good, useful, and a help. The responses were negative concerning the simplicity and successfulness of bilingual vocational education. On all other descriptors the groups were divided. The lack of clearcut polarization (opinions strongly for or strongly against bilingual vocational education) is evident in the fact that several groups responded positively - in terms of a mean weighted response - to such descriptors as valuable and good but negatively to such descriptors as important and necessary.

Looking at the data assembled by Salazar, it would be difficult to draw a consensus concerning the need for bilingual vocational education. A review of the open-ended responses shows very clearly the wide range of reactions to the need for bilingual vocational education programs at the secondary level. This chapter concludes with a sampling of responses received by Salazar concerning the need for bilingual vocational education.

A Sample of Responses by
Educators and Industrial Representatives

Bilingual Director
"I would like to see Texas A&M which is a leader in the area of Vocational and Adult Education, also take the lead in promoting and establishing sound Bilingual Vocational Education in areas of most need. I would support such an effort wholeheartedly."

Principal
"Note: Having worked with Mexican Americans for about 25 years--I believe we have now reached a level with very little need for bilingual education--25 years ago there was a great need--but not now."

Administrative Assistant
"I strongly support the bilingual vocational education program concept."

Administrative Assistant
"I hope, through present state bilingual programs, that students will not need this type of program in the secondary level."

Superintendent
"Most concentration on biligualism should be in early elementary years. I sincerely doubt that any child at the 11th or 12th grade level would not be able to comprehend English. The ones from Mexico may be the exceptions but we can hardly spend the $$$ necessary to plan for immigrants not yet arrived."

Superintendent
"I believe that all children should learn English and if we are not more demanding some children may use Spanish as an excuse not to learn English."

Principal
"It would be almost impossible to find a great number of bilingual vocational teachers. Bilingual education should be taken care of in lower grades and much of it in the homes before a youngster starts school."

Superintendent
"I feel this would have been a wonderful program 20-10 years ago-- The young people we have now in our school do not need a Bilingual Vocational Program. It may be an insult to many."

Director, Special Programs
"Bilingual education should not be continued past the elementary school. For a person to function in Texas and the total U.S he must utilize English. If Spanish is used for technical education the person is very limited for jobs."

Vocational Director
"Let's speak English."

Vocational Director
"Love it or leave it. The only reason Spanish speaking people are disadvantaged, if they are, is by telling them they are. Vivi Texas."

Vocational Director
"Provide the regular vocational teacher with resource people and aids to assist the Spanish speaking student until each becomes confident in the English language."

Vocational Director
". . . having had several years experience teaching vocational bilingually in Veteran training program I did not find it particularly effective. I believe it more practical to teach English as a second language preferably in elementary school."

Vocational Director
"I do not agree that bilingual education has a place in our educational system."

Vocational Director
"Students should learn their communicative skills in "communicative" classes and then vocational (skills) in vocational classes."

Vocational Director
"Other ethnic groups have had to learn to cope with the same problem,-- just another costly program that we are famous for in this country."

Vocational Director
"Bilingual teaching in our vocational programs would be a waste of much needed talent that could be used much more effectively elsewhere."

Vocational Director
"This whole idea is a waste of time, effort and money.

Vocational Director
"My people too were immigrants, coming from Germany. They took their place in an English society, learned the language and made a living. We are minorities only as long as we think of ourselves as such. I'm an American and I feel that if any bilingual training is done, perhaps in first or second grade."

Vocational Counselor
"There are many languages in Texas besides Spanish. They have had a chance to learn "enough" English by the time they reach high school."

Vocational Counselor
"I would rather see funds spent on teaching Spanish speaking adults to talk English so that they can teach their children the language of the U.S. and Texas."

Vocational Counselor
"I don't believe in setting up a special Vocational Education program for non-English speaking students - set up a class to teach in English separate from Vocational Education in the English department."

Vocational Counselor
"If I went to live in a Spanish speaking Nation, I would expect to speak Spanish not English and I would not expect special treatment but I would expect to work very hard to learn Spanish if I wanted to succeed in this new home of mine. I would change and not expect the Nation to change for me."

Vocational Counselor
"I believe it will amount to initially 100% instruction in Spanish and will remain at that level; therefore, I have doubts as to its usefulness. Ideally it would be a good program but we need to turn from the idealistic and face reality. I have been in schools where 85% were Spanish speaking and I believe I know what I am talking about. The expense would far outnumber the benefits gained and any extra funds should be placed in teaching fundamentals."

Secondary School Counselor
"I do not feel the public schools are responsible for establishing bilingual programs for Spanish-speaking students any more so than for Polish, Czech, etc. which we have not done. The responsibility for learning English rests upon the student, not the school. He must become a part of the U.S. language since he has chosen to live here. What type of bilingual program does Mexico have?"

Secondary School Counselor
"In the U.S. and Texas--English is the mother tongue. Mexican-American should be motivated to learn a command of the mother tongue in this country."

Secondary School Counselor
"I am not interested in bilingual programs at any level. I feel that our limited money must be spent teaching students to be English-speaking Americans if they are living in this country. A person who speaks, thinks, and writes another language totally will never feel a part of this country and will not be accepted by our citizens."

Secondary School Counselor
"A citizen of the United States should have skills in the use of the English language prior to the age for enrolling in vocational courses."

Secondary School Counselor
"Bilingual vocational training is unfair to the taxpayers and children of Texas. Programs are needed for those who would profit from training. Americans must care for Americans. We are not rich enough to adopt Mexico."

Secondary School Counselor
"Having spent 7 of my 10 years in predominantly Mexican American school systems I have seen only a very few students who did not have enough command of the English language to function well in vocational programs. I do not believe that the drop out rate of the Mexican American students is as much associated with language difficulty as it is with family expectations. I have had some very fine students whose parents spoke almost no English."

Industry Representative
"I think bilingual education tends to perpetuate the students Spanish-speaking abilities and discourages them from learning English."

Industry Representative
"I believe English should be taught in lower grades, teaching all children to read speak and write correctly and emphasis should be continued through secondary levels. Those students coming into secondary school unable to speak read or write English should be given concentrated guidance and instruction in English language before going any further in school. This would prepare them to be able to progress in either the academic or the vocational field."

Industry Representative
"There is no need for Spanish to be taught in America--Teach Spanish in Spain and Mexico--Teach English in America."

Industry Representative
"The student is in trouble if he does not know English well when he comes to high school. Bilingual should be used in the lower grades to help the student get started and then English only should be used."

Industry Representative
"I believe bilingual education in general has successfully succeeded in lowering the quality of education for all students."

Industry Representative
"My opinion is if I were to move to Mexico, I would expect to have to learn and master the Spanish language before I made much progress in any other field. I would not expect them to change their entire education process to accommodate me."

Industry Representative
"I cannot see any benefit to our society by spending any tax money for bilingual projects of any kind. It makes no more sense than having two monetary systems in the local society."

It is clear that the topic of bilingual vocational education is not without controversy. One of the major problems surrounding the issue is that there is no clear definition of the term, bilingual vocational education. Furthermore, there are no clearly stated goals for bilingual vocational education. There is general consensus that a problem exists, but there is much disagreement about the steps to be taken to assist persons of limited English-speaking ability.

CHAPTER 2

A REVIEW OF CONCEPT LEARNING STUDIES*

A review of the literature makes it evident that concept learning is a complex phenomenon, involving many variables some of which can be manipulated under normal classroom conditions and others which do not lend themselves to instructional manipulation. Examples of the variables which have been noted to influence concept learning are summarized in Figure 2.

Figure 2

Variables Influencing Concept Learning

Variable Category	Specific Dimensions
Characteristics of the Student	Age, IQ, SES, Personality Traits, Academic achievement, Ambition, Self-concept, Preoccupations, Cognitive Style
Characteristics of the Learning Situation	Presentation Mode, Reinforcement Schedule, Group Size, Labels, Extent of Exposure, Instructional Atmosphere
Characteristics of the Concept to be learned	Numerousness and Perceptibility of Instances, Concept Rule, Type of Instance, Concept Dimensions, Relevance of Attributes

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* The information presented in this chapter is summarized in an 11-page mini-report prepared by the project staff. The mini-report is contained in Appendix E. This chapter will be of primary interest to vocational teachers and researchers who plan to conduct similar or related research and thus desire a review of recently published studies in concept formation.

The literature indicates that the efficiency with which concepts are learned depends to a large degree on the characteristics of the individual learner, the nature of the concept to be learned, and the composition of the instructional setting.

It is evident from a review of the literature that there are two basic approaches to concept learning - the discovery approach in which the learner, with or without guidance, discovers for himself the critical attributes and rules governing a particular concept and a didactic approach in which the student is supplied with information that leads to concept formation. An excellent review concerning the relative merits of these two instructional approaches was made by Anderson, 1970. This study, although carried out by researchers who recognize the merits of a discovery approach to teaching, focuses almost exclusively on the traditional didactic approach to the teaching of concepts, the approach most commonly used in vocational education classes.

Concept Learning in the Classroom

Concept learning as a classroom phenomenon has been greatly benefited by D. Cecil Clark's (1971) comprehensive review and analysis of concept studies reported in the literature. Following a review of some 255 concept formation studies, Clark derived 61 principles of concept learning from what he called the "enormous stockpile of information" contained in the research literature. From his 61 principles, Clark wrote 16 prescriptions for teaching concepts in the classroom. Of his various prescriptions, Clark (1975) says that "the single most important step a teacher can take in teaching a conept is to identify its critical attributes" (p. 27).

Subsequent to the publication of his popular monograph, Clark made further studies on the implications of his 61 principles and 16 prescriptions for teaching concepts in the classroom. As a result of further research, Clark reduced his original set of 61 principles and 16 prescriptions to a set of 28 principles and 13 factors which affect concept formation. A discussion of Clark's revisions appears in Teaching Single Concepts: Procedures Based Upon Experimental Research (1975).

Klausmeier and associates at the Center for Studies in Cognitive Learning (University of Wisconsin-Madison) have amassed an extensive body of research in concept learning. They have formulated a tentative theory of concept learning which is discussed at length in Conceptual Learning Theory (1974). In this publication, Klausmeier, et al. describe the attributes presumably belonging to all standardized concepts which make it possible to learn concepts. The attributes which Klausmeier et al. have identified account in part for the relative ease of difficulty with which certain concepts are learned. Included among these attributes are:

1. Learnability: the relative ease with which a concept is learned (this can be determined for particular populations through the use of an instance probability analysis).
2. Useability: the application that can be made of a concept in problem-solving, in the formation of additional concepts, and reducing the complexity of an environment.
3. Validity: the extent to which the experts agree on the definition of a particular concept.
4. Generality: the number of subclasses and subordinate concepts which a concept encompasses.
5. Power: the extent to which a concept facilitates the acquisition of additional concepts.
6. Structure: the rule by which the attributes of a concept are related to each other.
7. Perceptibility: the extent to which a concept can be sensed.
8. Numerousness: the relative number of instances of a concept that can be observed or imagined.

Variables Affecting Concept Learning

Even in carefully controlled laboratory settings it is difficult to account for all of the factors that influence the acquisition of concepts. In the typical classroom setting, these factors are so numerous they can seldom be isolated for careful study. For purposes of this study a review has been made of (1) characteristics of the learner, (2) learning situation variables, and (3) concept variables.

Characteristics of the Learner

Other things being equal, the characteristics of the learner will often predetermine the efficiency of performance in a concept learning task. Certain learner characteristics, such as IQ, socio-economic status (SES), and age have been found to influence concept learning but the teacher can exercise virtually no control over such variables. For learners of all ages, intelligence has been found to be an accurate predictor of concept formation (Jacobsen, Millham, and Berger, 1970; Marx, 1970; Laughlin, Doherty, and Dunn, 1968; Piland and Lemke, 1971; Switzky, 1973; Denney, 1973). The effects of SES on concept learning have been investigated, but the findings are inconclusive. Guthrie (1971), Nazzaro and Nazzaro (1973) reported that high SES subjects learned certain concepts more efficiently than low SES subjects. Securro and Walls, (1971), however, found that concept attainment was not affected by SES. Age, like IQ, has been found to correlate positively with the rate and efficiency of concept learning (Johnson, Warner, and Silleroy, 1971; Schalder, 1973; Nolan, 1974).

Certain learner traits which affect concept attainment can be manipulated through training procedures, thus are of practical interest to classroom teachers. When concepts must be inferred from a set of stimulus cues, impulsive students have been noted to require significantly more trials to solution than reflective students (Brigg and Weinberg, 1973; Denney, 1973; Reid, 1974). Berquist and Klemm (1973) found that low-anxiety students (on the "Welch Anxiety Scale") acquired concepts more rapidly than did high-anxiety students. Hollenberg (1970) found that high-imagery students were superior to low-imagery students (matched for sex, age, and IQ) in the initial learning of the names of objects.

Using a bisensory digit-span task, Ingersoll (1970) identified "visual attenders" and "aural attenders." When the preferred dimension was relevant to the solution of the task, Ingersoll found that it significantly influenced levels of attainment. Davis and Klausmeier (1970) found that cognitive style also influences concept identification performance. Individuals whom the authors identified as high-analytic solved concept-identification problems with greater ease than did low-analytic subjects. Again, it was learned that pretraining procedures could be used to ameliorate the disparity between students who scored high and those who scored low in an embedded figures test.

Awareness of the effects of various learner characteristics on concept learning coupled with a knowledge of the specific strategies for minimizing or maximizing these effects should make it possible for the teacher to improve the overall level of concept attainment in the classroom.

Characteristics of the Learning Situation

Considerable research has been done to determine the influence on concept learning of various factors that can be manipulated in a classroom setting. McMurray (1974) investigated the effect on learning of four presentation conditions: (1) wide variety, multiple instances presentation; (2) wide variety, single-instance presentation; (3) narrow variety, multiple-instances presentation; (4) narrow variety, single-instance presentation. Sixteen subjects were assigned to each treatment. A dependent measure was constructed to measure the ability of the subject to select positive examples from an array of related instances, and to correctly classify previously unencountered instances of the concept. In an analysis of the data, all differences were in favor of the superiority of the wider variety of concept instances for "effecting significantly more correct classifications of previously unencountered instances than did the narrow variety repeated" (p. 57). McMurray, (1974) in citing the significance of her study, made the following observations:

> First, the individual classroom teacher who is looking for the most effective manner in which to present a concept would clearly select as wide a variety of instances feasible within available resources and resource materials. Second, if time contraints were such that only a certain number of instances could be presented, presentation of a wider variety of concept instances . . . rather than repetition of only a few would be most likely to promote better concept learning. Third, when using a wide variety of concept instances, the teacher would match examples with nonexamples or irrelevant attributes and present them together as matched pairs in order to focus student attention on the only differing and relevant attribute (p. 68).

In a study of trait-treatment interaction between aptitude and instructional media, Snow and Salomon (1968) found that low-ability students acquired concepts more rapidly and with better recall with live presentations than with passive (film) presentations. The effect on performance of varying the amount of detail in a pictorial presentation of a concept, Gorman (1973) found a lack of significant differences in performance in relation to (1) the amount of pictorial detail (line drawings versus detailed drawings), (2) presentation strategy (successive presentations of single instances versus simultaneous presentations of multiple instances), and (3) grade level (fifth graders, ninth graders, fifteenth graders). A 3 x 2 x 2 (grade level x pictorial detail x presentation strategy) factorial posttest-only design was used. Mean scores across the three grade levels for minimum pictorial detail (9.3, 9.3, 10.6) were not significantly larger than maximum pictorial detail (9.2, 8.9, 9.7) for the simple concept. This trend also held for the complex concept.

Nelson (1972) found that greater visual detail may be needed when ambiguous concepts are undergoing the process of differentiation. As students become more familiar with a concept, however, Nelson contends that less visual detail may be needed.

In an analysis of eleven studies reported in the literature, Nielson (1970) found seven studies (for tasks involving recall, recognition, and concept learning) in which pictorial stimuli were superior to verbal stimuli, two studies in which verbal stimuli were superior to visual stimuli and two studies in which no significant differences were noted. Caput (1974) notes, however, that a careful analysis of the findings of such studies suggests that the superior effectiveness of pictorial modes over verbal modes is a function of the concreteness or abstractness of the subject matter. Superiority of the pictorial mode tends to disappear for conveying content which has non-concrete or action-process characteristics. Similar findings of the superiority of pictorial stimuli have been noted in paired-associate tasks (Sampson, 1969; Wicker, 1970; Rowe, 1972).

Based on a review of previous research, Lewis (1970) concluded that below average students learn concepts better through pictorial presentations and profit more from pictorial multiple-choice test options than from verbal presentations and verbal multiple-choice test options. She concluded further that for complex, complicated concepts the best mode of presentation is a visual demonstration.

A popularly held assumption is that certain students learn concepts more effectively from "real" objects which can be manipulated than from pictorial representations of the concepts. Numerous researchers taking this position advocate a liberal use of concrete objects in the teaching of concepts to young children. For college students, Fishkin and Fishkin (1970) found no significant differences between tactual and visual modalities for processing information provided that the stimulus dimensions in the discrimination task could be discriminated both visually and tactually.

Baker and Popham (1965) designed a study in which groups of students enrolled in a teacher preparation program at the University of California were presented identical sets of instructional materials, with the exception that one set of materials had pictorial embellishments (cartoons, etc.). Posttest data indicated that there were no significant differences for variables associated with achievement. There were, however, significant differences in favor of the embellished version of the materials in an affective rating by the students.

Caput (1974) made a study of the comparative effectiveness of four different visual-verbal presentation modes. The four modes-- Spoken verbal (S); Printed verbal (Pr); Spoken verbal with printed verbal (SPr); and Spoken verbal with still pictures (SP)-- were examined in each of the two experiments in which a randomized posttest-only design was used. As a measure of the dependent variables, Caput used three objective criterion tests to measure three cognitive learning tasks: Learning facts, following procedures, and classifying concepts. Following an analysis of the data derived from his study, Caput drew the following conclusions:

> 1. . . . the sound/pictorial mode tended to be the most effective mode for classifying concepts.
>
> 2. . . . presenting nonredundant information simultaneously through both audio and visual channels resulted in higher levels of performance than through either channel alone.
>
> 3. Providing relevant pictorial cues rather than presenting verbal information alone produced high performance in learning facts and classifying concepts.
>
> 4. Audio and print forms tended to yield equally effective levels of performance on cognitive learning tasks.
>
> 5. Pictorially-supplement presentations produced higher levels of achievement on pictorial tests than did verbal-only presentations. (p. 91)

Several studies have been made to investigate the superiority of the auditory and the visual sensory channels. Superiority of either channel appears to some extent to be task specific, that is, to be related to the nature of the task. Under circumstances of high redundancy, the combined use of both the auditory and the visual channel appears to be superior to either channel alone (Hsia, 1968; Hartman, 1961). Otherwise, studies which have found visual presentations superior to aural presentations (Schulz and Kasschau, 1966; Van Mondfrans and Travers, 1964; Baker and Payne, 1969) are counterbalanced by studies which have found the superiority associated with the auditory mode (Margrain, 1967). Ann Lewis (1970) notes several advantages and disadvantages of both types of presentation modes:

> 1. . . . The visual presentation alone is capable of teaching a concept . . . Verbal presentation facilitates a need for knowledge of technical vocabulary; and uses less time . . . A difficult concept is best taught through a visual presentation. . . Transfer is facilitated best between visual and verbal presentation.
>
> 2. With regard to sheer quantity of sensory response, verbal stimuli, because of their less restrictive nature, are superior to visual stimuli.
>
> 3. Pictures are more easily remembered than words due to their more distinctive characteristics.
>
> 4. The efficiency of visual presentations in learning decreases with age.
>
> 5. Certain types of words (verbs) accompanying pictorial presentations are more effective in aiding teaching. (p. 272)

Razik (1971) found that concept learning can be impaired by allowing an insufficient amount of time for students to attend to cues presented audiovisually. Sanders, Di Vesta, and Gray (1972) found that a presentation strategy in which similar instances were blocked led to more rapid acquisition than did intermixing the instances.

Another variable having a significant effect on concept learning is the mode of responding. Rowe (1972) found that verbal responding during a discrimination learning task was superior to non-verbal responding (pushing a button) for college students. In a replication of the study with fourth grade subjects, Rowe again found differences in the direction which favored a verbal over a non-verbal response mode, but the differences fell short of the

.05 level of significance. Facilitative effects of verbalization in concept learning tasks have also been noted by King and Holt (1970) and Osler and Madden (1973). Lewis (1970) summarizes her findings on the effects of verbalizing in the following manner:

> 1. Verbalizing the correct dimensional value facilitates shifting.
> 2. With very young children, verbalizing the correct response was better than no response.
>
> . . . .
>
> 5. With familiar material, overt responses are insignificant in facilitating problem-solving.
> 6. Speaking-first training, as opposed to listening-first training, best facilitates learning.
>
> . . . .
>
> 8. While overt verbalization facilitates concept attainment, the explanation for this is unknown. (p. 273)

The acquisition of a praxeological concept (one requiring a motor-type performance) was studied by Clark (1967) who found that students who conceptualized how to complete a task performed less well on a final posttest than students who actually practiced the task (the shaping to specification of a piece of electric metallic tubing). In addition to examining the influence of overt responding on the attainment of the praxeological concept, Clark also examined the effect on learning of seven student ability factors (reading ability, arithmetic ability, academic ability, motor skills, spatial perception, communications skills, and general ability).

Of the seven factors, the two most reliable predictors of concept acquisition performance in the Clark study were motor skills ability and spatial relationships. Based on the findings of Clark, it would appear that overt response modes in concept acquisition tasks are in most instances superior to passive response modes.

Reinforcement of correct responses has been found to increase both the rate of learning concepts and the efficiency of learning them (Bucher, 1973; Viel, 1975; Silver, Saltz, and Modigliani, 1970; More, 1969; Siegel and Downey, 1970; Cahoon, 1970). There appears, however, to be uncertainty about the manner in which reinforcement should be given. Cahoon found superior results with an intermittent feedback schedule; others have found continuous feedback to be superior. Negative reinforcement has been found by some to be superior to positive reinforcement; others have noted the opposite. More (1969) found delayed-feedback to be superior to immediate-feedback. Bucher found that the benefits of reinforcement were diminished when a competing reinforced activity was also available. Smith (1975) made an interesting finding: In a concept learning task the students assigned to a feedback and practice condition did significantly better than students assigned to a practice-only treatment. The effects of providing cues, examples, practice, and feedback were found to be cumulative with the best performance done by the group receiving the combination.

Feedback given during a concept learning task (usually referred to as prompting) has also been shown to facilitate concept attainment (Merrill and Tennyson, 1971). However, Hardman and Drew (1975) found that the greater the reinforcement in a concept learning task the less the rate of incidental learning.

The use of labels in concept learning has also been studied in depth. Providing highly meaningful labels facilitates concept attainment to a greater extent than low meaningful labels (Frederick and Klausmeier, 1968; Stones, 1970; Stephens, 1968; Kofsky, 1967; Di Vesta and Richards, 1970; Rosenthal, Alford, and Rasp, 1972; Gargiulo, 1974). Etaugh and Averill (1971) found that student-produced labels for stimuli in a discrimination learning task were not superior to experimenter-imposed labels--provided the latter were meaningful to the student. Dickerson (1970) found that the learning of distinctive names (labels) for relevant cues in a discrimination problem was superior to the learning of labels for the irrelevant cues.

Although not widely examined, researchers have sought to determine the effects of grouping on concept learning tasks. Klausmeier (1974) found that students in groups inferred concepts in fewer trials than students working individually. Piland and Lemke (1971) found no significant difference in learning efficiency for either homogeneous or heterogeneous grouping conditions. In a later study however, Lemke, Leicht, and Miller (1974) found that for low-ability students, training to induce a particular concept in heterogeneous groups resulted in better transfer performance than did training in homogeneous groups. The authors presumed that the verbalizations of extroverts in the heterogeneous groups facilitated the acquisition of solution strategies for the low-ability students.

Just as feedback influences concept learning so does pre-instructional activity. White, Richards, and Reynold (1971) found a significant inverse relationship between the number of pre-training problems students received and the number of trials to criterion. Moore, Hauck, Biddle, and Houtz (1973) found that the acquisition of concepts was improved by the imposition of a risk condition--loss of reward for incorrect performances. Weisberg (1970) found that "advance organizers" (introductory lessons on the concepts to be presented) facilitated the learning of concepts. Levie and Dickie (1973) also noted facilitative effects of organizers for directing attention to relevant attributes. Viel (1975) found that a preinstructional explanation of the use of instructional objectives significantly influenced the attainment of concepts.

Concept Variables

The nature of a concept itself predetermines in part the ease or difficulty in which the concept will be learned. Some concepts can be easily learned from definitions alone, provided the meanings of the definitions are accessible to the student (Anderson and Kulhavy, 1972). Other concepts are more readily learned from combinations of definitions and rational sets of instances (Feldman, 1972). Some concept attainment tasks are facilitated by the use of negative instances, others by the use of positive instances, still others by combinations of positive and negative instances (Tennyson, 1973). Markle and Tiemann (1973) have found that positive instances produce significantly better generalization than negative instances and that negative instances produce significantly better discrimination than positive instances.

Clark (1975) has found that the more critical attributes a concept has the more discriminators (closely related non-examples) it is likely to have, hence the more precise the teaching must be in order to prevent misconceptions. For this reason, Clark distinguishes between negative examples which differ from a concept by only one attribute or dimension and negative examples which differ along several dimnesions. He emphasizes the importance of drawing attention to the single attribute on which a concept and its discriminator(s) differ. Houtz, Moore, and Davis (1973) have had similar findings to those of Clark.

Not only does the type of instance influence concept learning, the number and type of attributes of an instance likewise influence concept attainment. A linear increase in the number of instances to solution and performance errors has been reported as a function of increasing numbers of attributes (Looney and Haygood, 1968; Laughlin, Chenowith, Farrell, and McGrath, 1972; Granzin, 1975).

Houtz, Moore, and Davis (1973) found that in a nondimensioned concept learning task, when the relevant attributes remained constant across instances, the most efficient learning occurred when all of the irrelevant attributes changed. When the relevant attribute changed from one instance to the next, as in the case of alternating positive and negative instances series, the most efficient learning occurred when the irrelevant attributes remained constant.

When presenting a definition with conjunctive relationships between the critical attributes, Markle (1975) found that the technique of arranging the critical attributes on separate lines produced better classification than did a linear prose presentation of the same words.

Several studies have found that increasing the number of irrelevant attributes across instances inhibits concept learning because it reduces the capability of students to attend to and utilize the relevant attributes of the stimuli (Amster, 1966; Edmonds and Mueller, 1970; Scandura and Voorhies, 1971). Similarly Champione and Beaton (1972) have found that the magnitude of transfer from one task to another is in part a function of the similarity of the stimuli.

Tennyson, Woolley, and Merrill (1972) found the following:

1. The combined use of high- and low-probability exemplars matched (irrelevant attributes of exemplar and nonexemplar are as similar as possible) and divergent (two exemplars with irrelevant attributes as different as possible) resulted in correct classification.
2. The use of low (or all levels), unmatched, and divergent exemplars resulted in overgeneralization.
3. The use of high-probability exemplars, matched and divergent resulted in undergeneralization.
4. The use of all levels of probability exemplars, unmatched and convergent exemplars resulted in misconceptions.

The systematic management of instructional materials has been shown to have a pronounced effect on the learning of conceptual information (Frase, 1975; Merrill and Boutwell, 1973; Baker, 1973; Levie and Dickie, 1973). The type of concept to be learned determines in part the appropriate type of media to convey the concept. Several models have been devised for making decisions relevant to the selection of media (Tosti and Ball, 1969; Van Mondfrans and Houser, 1970; Dwyer, 1972). While the models differ in some respects, the majority of them entail some type of scheme for matching the attributes of the medium, the characteristics of the learner, the attributes of concepts to be taught, and the instructional objectives to be attained.

A problem that faces the researcher who chooses to examine the effect on learning of various types of visual illustrations is that of trying to conclude whether one stimulus item actually conveys information in a more efficient manner than another item or whether one type of illustration simply illicits a higher rate of attending (orientation to the task at hand) with the possible consequence of a greater rate of learning. At Pennsylvania State University, Francis Dwyer has been conducting studies since 1968 on the instructional use and effectiveness of visual illustrations. In his Guide for Improving Visualized Instruction, Dwyer (1972) presents a realism continuum for visual illustrations. His continuum is based on the following rationale: "The more qualities a visual has in harmony with the object or situation which it is to denote, the more realistic the visual is said to be" (p. 5). Based on this rationale, Dwyer developed a series of visual illustrations to accompany a 2,000 word instructional unit on the human heart. Dwyer ranked his visuals as shown in Figure 3.

In a series of studies utilizing college students, Dwyer held a 2,000 word script constant but varied the visual stimuli for different treatment groups. His intent was to determine the effectiveness of the various visual stimuli in facilitating learning. His dependent variables consisted of four individual criterial tests (an 18-item drawing test, a 20-item identification test, a 20-item terminology test, and a 20-item comprehension test) for a total of 78 items which were designed in Dwyer's words "to measure

Figure 3

Visual Presentation Formats Used
In the Dwyer Study (1968)

Simple Line Drawings of Heart (Black & White)	Simple Line Drawings of Heart (Color)	Detailed, Shaded Drawings of Heart (Black & White)	Detailed, Shaded Drawings of Heart (Color)	Heart Model Photographs (Black & White)	Heart Model Photographs (Color)	Realistic Heart Photographs (Black & White)	Realistic Heart Photographs (Color)
LOW							HIGH

the student's total understanding" (p. 19). In terms of strict statistical significance, Dwyer found overall differences in the effectiveness of the various presentation formats--favoring black and white line drawings--and he also found significant interactions between his dependent variables (criterial tests) and certain types of visual illustrations. Because of this observed interaction, Dwyer concluded "that the realism continuum for visual illustrations, when used to complement oral instruction is not a realiable predictor of learning efficiency" (p. 22). But he did add that generally speaking "the more realistic illustrations were found to be the least effective in complementing oral instruction" (p. 22).

Summary

Many variables influence concept learning. The fact that these variables can to some extent be manipulated through instruction indicates that concept learning can become quite efficient. Identifying the concepts to be taught and manipulating the variables which influence concept learning are an important part of teaching. This chapter illustrates many of the variables that researchers have controlled in order to improve concept learning. Vocational teachers, too, can identify the factors which optimize vocational concept learning.

CHAPTER 3

EXPERIMENTAL PROCEDURES FOLLOWED IN THE STUDY

Preparation for the study took place over a four month period and included such activities as (1) negotiating with school administrators to conduct the study; (2) developing and field testing instructional materials in both Spanish and English; (3) developing and analyzing test items; (4) securing parental permission for students to participate in the study and (5) making arrangements to conduct the study with minimum interruption of normal school activities. The following account of procedures used in the study is intended to assist vocational education teachers or researchers to replicate portions of the study.

Development of the Instructional Lesson

Several lesson formats were reviewed before the selection of a particular format for this study was made. Lesson formats designed by Becker, Engelman, and Thomas (1971); Markle and Tiemann (1969); Asbury (1971); Klausmeier, Ghatala, and Frayer (1974); and Clark (1975) were considered. Each instructional format was developed specifically for teaching concepts, and the effectiveness of each format had been documented through research. After considering the merits of each format, the one developed by Clark was selected over the alternatives because of its substantial theoretical base and because Clark (1975) himself said that this instructional format was "especially helpful in teaching concepts" . . . (p.II).

There are five principal components in Clark's format for teaching concepts: (1) identification of critical properties, (2) formation of an objective, (3) selection of materials, (4) presentation of the concept, and (5) evaluation of concept formation. Based on this format, a lesson plan was developed for teaching each of the concepts presented in the study. The lesson outline for one of the concepts, the standard flat head wood screw, is given below:

Lesson Plan for Teaching the Concept "Standard Flat Head Wood Screw"

I. Identification of critical properties

A. Critical properties:
1. A flat head with a straight slot across the diameter
2. A bearing surface that tapers inward toward the body
3. An upper portion of the body (approximately one-third of the body) with no threads
4. A lower portion of the body (approximately two-thirds the length of the body) with threads
5. A pointed base

B. Noncritical properties:
1. Type of metal or finish
2. Size of diameter and length

II. Formation of an objective

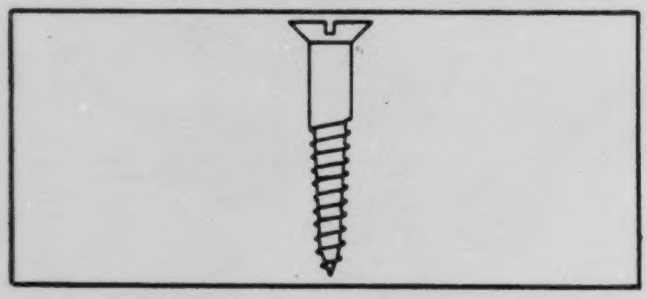
Following the completion of a prescribed set of instructional materials, the student will have formed the concept "standard flat head wood screw." As evidence of this, he will be able to:

1. Discriminate positive instances of the standard flat head wood screw from other types of metal threaded fasteners

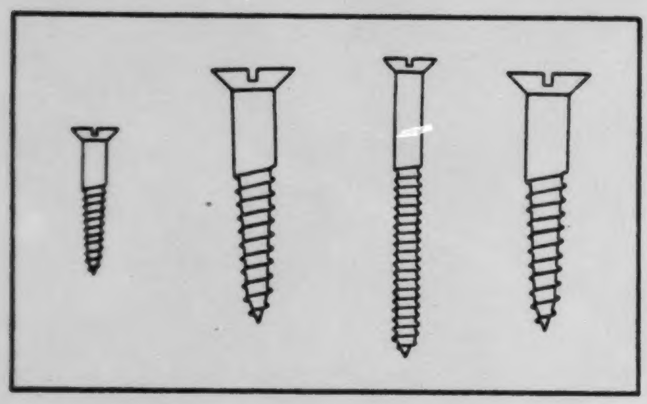
2. Distinguish between standard flat head wood screws and closely related concepts such as the flat head sheet metal screw, the flat head machine screw, and the flat head cap screw
3. Generalize across a group of positive instances and discriminators
4. Select new instances of the concept from an array of metal threaded fasteners

III. Selection of materials

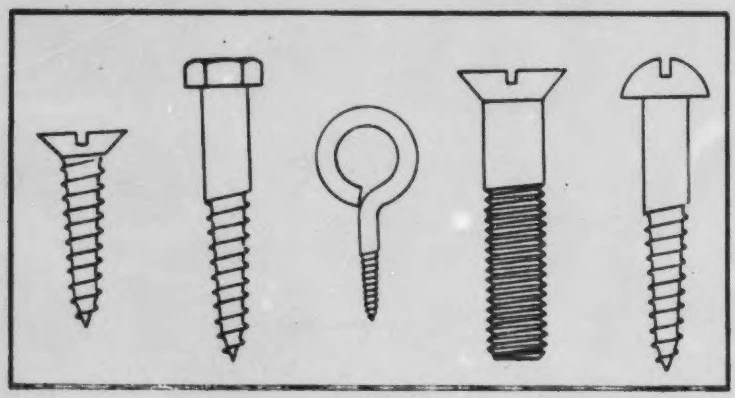
A. Positive instance for formative stage:



B. Positive instances for confirmatory stage:



C. Discriminators for formative and confirmatory stages:



IV. Presentation of the concept

A. (See Appendix A for a sample of the materials used)

V. Evaluation of the concept formation

A. Formative evaluation (See Appendix A for a sample of the materials used)

B. Summative evaluation (See Appendix B for a sample of the materials used)

The lesson format depicted in the preceding presentation was used to develop the instructional materials for the study. The visual content conveyed by the various instructional materials is summarized in Figure 4.

Development of the Instructional Materials

The development of the instructional materials for the study was carried out over a period of months. The principal production techniques used in the development of the materials will be briefly described in this segment of the report. In order to carry out the

Figure 4

Summary of Content for the Instructional Materials

	Total Number of Instructional Frames	Total Number of Positive Instances Presented	Total Number of Critical Attributes Taught	Total Number of Nonexamples and Discriminators Presented	Total Number of Formative Test Items	Total Number of Summative Test Items
Hexagon Head Bolt	13	16	5	8	10	9
Round Head Machine Screw	14	20	4	9	11	9
Filister Head Cap Screw	13	17	4	6	10	9
Grand Total	40	53	13	23	31	27

several sub-studies, two basic sets of instructional materials were developed. Before developing the materials, several concepts were considered for use in the research. Finally, two different types of concepts were selected for use. Metal threaded fasteners were chosen as one type of concept, and certain plumbing symbols were selected as the second type of concept.

Development of Fastener Materials

Metal threaded fasteners were selected because they were transportable and they could be graphically represented. Before preparing the materials to teach the various fasteners, an analysis was made of the critical and the noncritical attributes of each type of fastener. This was done so that examples which exemplified each of the noncritical attributes could be drawn. A standard reference text on fasteners was used as the basis for identifying the critical and noncritical properties of the fasteners. These included (1) the type of metal and finish used in the construction of the fasteners (hence the color was irrelevant) and (2) the diameter and length of the fastener. Although critical dimensions are associated with some of the fasteners, it was felt that because the fasteners normally can be purchased only within certain standard parameters that these attributes could be considered noncritical for purposes of the study. An anlysis was made of the critical attributes of each fastener included in the study, a summary of which is given in Figure 5.

Figure 5

Critical Attributes of Five
Metal Threaded Fasteners

Concept	Head	Bearing Surface	Body	Base
Hexagon Head Bolt	Hexagon-Shaped With Straight Sides	Forms Right Angle With The Body	Threaded Up To Two-Thirds of The Body	Pointed
Round Head Machine Screw	Rounded With Straight Slot or recessed	Forms Right Angle With Body	Completely Threaded	Flat
Fillister Head Cap Screw	Slightly Rounded Head With Straight or Recessed Slot	Forms Right Angle With The Body	Can be Wholly or Partially Threaded	Oval-shaped

Following the analysis of concept attributes line drawings were prepared. Line drawings ranging in size from 10cm. to 17cm. in length and 2cm. to 4cm. in diameter were drawn with the use of Rapid-O-Graph pens (numbers 00-4) and standard drafting instruments. The original drawings were mounted on a sheet of cardboard measuring 55.88 cm. by 76.20 cm. and were photographically reduced to 50% and 25% of their original size. From the reductions, ENCO 1250 metal plates were prepared for use on a 1250 multilith offset press in the production of master copies suitable for the development of the instructional materials. When assembled, the master copies were used to print packets of instructional materials using a 1250 multilith offset process (see Appendix A). Based on a review of the effects of visual emphasizers, it was decided to use arrows to direct the students' attention to the various critical attributes that would be emphasized in the instructional materials. Conservation use of these attention-focusing devices was made based on the findings of Hartman (1961) that such devices "are of value only if they neither distract from learning which is already taking place nor continue in competition with the material to which they are supposed to direct attention" (p. 41). In addition, it was decided to enclose each of the instruction sets in distinctive frames with identifying letters affixed to the upper left corner. This was done to facilitate the coordination of the visuals with the accompanying audio transcriptions.

Audio Scripts

A script was developed using the technical language of the fastener industry. It was necessary to keep the language of the script as simple and meaningful to the learner as possible, but at the same time maintain a reasonsable degree of technical integrity as most tradesmen use the terms of their trades and expect others to use the same technical terminology. (Those who have tried to purchase replacement items for mechanical devices have undoubtedly already found this to be true.) The script which was developed (see Appendix C) conformed to Clark's lesson format and included the standard terminology used in the fastener industry.

After the scripts were developed, audio transcriptions were made by an individual who held a First Class radio announcer's license. The same individual was used to produce all of the transcriptions. To ensure the quality of the recording they were recorded with the use of a reel to reel, semi-professional recording desk (Pioneer Model RT 1050) at 7.5 inches per second on 1.5 mil. Scotch 206 Professional Mastering Tape. A Micho AKG ST-707 Unidirectional Voice Microphone was used. The reel to reel transcriptions were then transferred to cassette tapes for convenience and to make them useable on standard equipment that was available in the classroom.

Irrespective of the number of technical words appearing in the scripts, an effort was made to keep the overall level of communication comprehensible for the students involved in the study. To monitor the level of communication for the various scripts, the Easy Listening Formula (ELF) developed by Irving E. Fang (1966) at the University of California was used. The ELF was designed to measure the average sentence difficulty of television newscasts.

The correlation between the ELF and the Flesch Reading Ease Formula was +.96 for 36 television scripts and 36 newspaper samples. Based on an analysis of 152,890 words of text, Fang found that the ELF scores of the most highly rated television news programs averaged around 12. By comparison, an analysis of the scripts used in this study averaged 4.15. A breakdown by concept of the ELF scores is given in Figure 6.

Figure 6

Easy Listening Formula
Analysis of Scripts
Used in the Study

CONCEPT	TECHNICAL
Hexagon Head Bolt	4.42
Round Head Machine Screw	4.33
Fillister Head Cap Screw	5.00
AVERAGE E.L.F. SCORE:	4.58

Development of the Dependent Measure

A test was needed which would assess the ability of the students in the study to (1) correctly select positive instances from an array of related concepts including close-in nonexamples (nonexamples which differ from examples by only one attribute), (2) select nonexamples within both closely matched and divergent pairs, and (3) generalize across groups of positive and negative examples. In addition to meeting the usual criteria of validity, reliability, and useability, the test items were expected to follow certain rules cited in the literature by Markle and Tiemann (1975). "All the examples and nonexamples the student is asked to process will be new and will bear a predictable relationship to the domain of the concept. Concepts can neither be taught or tested by a single example" (p. 3). To satisfy the latter requirement, the three equivalent test forms were constructed from sets of examples and nonexamples which had been photographically reduced to make them differ in size from the examples and nonexamples used in the instructional materials.

In its final form, the test was comprised of the following items: (1) 30 items which required the students to correctly classify a single positive instance from an array of five related concepts, (2) 10 items which required the students to identify nonexamples when shown a matched pair or a divergent pair of related concepts, (3) five items which required the students to correctly identify all of the positive instances in an array of related instances of which at least two were positive instances.

Face validity of the test was presumed to be adequate inasmuch as the examples which comprised the test were identical except in size to the items used in the instructional materials. Four instructors with extensive backgrounds in Agricultural Engineering and Industrial Education were asked to review the content of the test for accuracy. The only error noted in the test was the identification of a Phillips-recessed flat head wood screw as a standard flat head wood screw. This item was corrected upon verification of the error in a standard reference text.

Content validity was built into the test by the choice of items which were capable of measuring:

1. Overgeneralization--all positive instances plus some noninstances are classified as concept instances.
2. Undergeneralization--not all of the positive instances and some noninstances are classified as concept instances.
3. Misconception--noninstances only are classified as positive concept instances.
4. Concept formation--positive instances only are identified as examples of a concept.

Reliability of the test was first examined by a comparison of the mean scores obtained in a single administration of the test by a group of Agricultural Engineering undergraduates at Texas A&M University (a group presumably knowledgeable in the content of the test) with the mean scores obtained by a group of disadvantaged students from a local high school. A significant difference between these two groups was obtained; the former group obtained a mean of 67 percentile while the latter group obtained a mean of 30 percentile (a mean which could largely be attributed to the guessing factor). Reliability of the test was further examined by administering it to students enrolled in various vocational education and educational psychology classes at Texas A&M University. A test analysis was made on the basis of how students rated their knowledge of fasteners. The tests were analyzed by the Test Scoring Service of the Data Processing Center at the university. For 26 students rating their knowledge of fasteners as medium or better, the modified Kuder-Richardson (K-R) 20 reliability coefficient was .863; for 25 students rating their knowledge of fasteners as low the modified K-R 20 reliability coefficient was .715. For a group of eight students from Snook Independent School District, the K-R 20 reliability coefficient was .944 following the treatment.

Development of Materials to Teach Plumbing Symbols

Following the preparation of the fastener materials, materials were prepared for teaching selected plumbing symbols. The same lesson format and drawing techniques were used in the preparation of the plumbing materials. Unlike the fasteners, however, the plumbing symbols were more complex in nature, that is, a single symbol could convey multiple meanings. For example, the symbols used in this study have three principal components each of which represent a different set of items or functions. The middle part of the symbols denote different types of pipe valves, either globe, safety, or gate valves. The ends of the symbols denote the type of joint or the process by which the valves are connected to pipelines. There are different symbols to indicate whether the joints are welded, soldered, or threaded. Finally, there are symbols indicating the function of the pipes to which the valves are connected. There are symbols to indicate hot water pipes, cold water pipes, gas lines, air lines, and so forth. Thus in this material, a single visual representation could denote (1) the type of valve, (2) the type of joint and (3) the type of (of function of) the pipe connected to the valve. A decision was made to teach each symbol component (type of valve, type of joint, and type of lead pipe) as a separate concept. These instructional materials are illustrated in Appendix A.

Development of Test Materials

To assess the extent to which students learned the various plumbing symbols, two types of tests were developed. One test measured only the attainment of simple concepts: "Select the gate valve"; "Select the valve with soldered joints". A second test asked compound questions: "Select the globe valve which has been welded to cold water pipes"; "Select the safety valve connected to hot water pipes with threaded joints". Two forms (pre- and posttest) for each test were developed and field tested using a class of college students who were majoring in the building trades field. A copy of the final instrument is included in Appendix B. Validity and reliability checks described for the fastener tests pertain to the valve tests as well and thus will not be repeated here. For each test item, a discrimination coefficient was calculated based on the performance scores of the upper and lower third of the 30 building trades majors who participated in the pilot test of the examination. Items with discrimination coefficients of less than .30 were changed. Discrimination coefficients for subsequent administrations of the tests consistently fell within the desired range of .30 and above. In Appendix D, the discrimination coefficients for several test adminstrations are listed.

Translation of the Materials from English to Spanish

The translation of materials from English to Spanish was far more difficult than initially anticipated. First, there was the problem of selecting the most appropriate form of Spanish. Many of the bilingual students participating in vocational programs speak a unique version of Spanish called Tex-Mex. To further complicate matters, the form of Tex-Mex common to one region is different in subtle but perceptible ways from that which is spoken in another region. After conferring with experts in the modern language department, it was decided to translate the materials into standard Spanish.

The next problem in the translation of the materials was the translation of technical terms. Bilingual employees in several large hardware stores were contacted and virtually all of them indicated that the names of common hardware items are not translated from English to Spanish. They indicated that a Spanish-speaking customer who wished to purchase a Hexagon Head Bolt would use the same technical term as an English-speaking customer, i.e., "Hexagon Head Bolt." Furthermore, several of the across-the-counter distributors indicated that the majority of persons (both Spanish- and English-speaking) who order parts and supplies bring a sample item and simply say: "I want five of these things" (obviously ways have been devised to compensate for language barriers!)

Strangely enough, we found that persons who had immigrated to the United States from Spanish-speaking countries could translate technical terms much more readily than Spanish-speaking persons who were native to Texas. In time, an individual was identified who had the appropriate trade background to translate the technical terms into Spanish. Next, a bilingual technical writer from the Agricultural Communications Department of the Extension Service was asked to review the translations. After this review, the translations were again reviewed and corrected by an expert in the modern languages department. The materials were then recorded by three different persons: an individual who prepares Spanish materials for the Extension Service, an individual who prepares language laboratory tapes for Spanish classes, and a Mexican-American student associated on a part-time basis with the project. The Spanish scripts for the various instructional materials are included in Appendix C.

Selection of Schools to Participate in the Study

Specific procedures were followed in order to secure the participation in the study of students from six school districts. In all instances, a formal request was submitted to the superintendent of schools. Following the formal request, personal appearances were made to the superintendent of schools by the principal investigator of the study. In most instances, several preliminary meetings were held between project staff and school administrators. In addition, at least one orientation meeting also was held with the teachers of students who were involved in the study. Although these pre-study contacts were time-consuming, they had beneficial effects on the subsequent conduct of the various studies.

Permission to conduct portions of the research was obtained from the following school districts:

1. Corsicana Independent School District, Corsicana, Texas.
2. Allen Academy, Bryan, Texas.
3. Del Valle Independent School District, Del Valle, Texas.
4. Weslaco Independent School District, Weslaco, Texas.
5. Dallas Independent School District, Dallas, Texas.
6. Ector County Independent School District, Odessa, Texas.

Information protected by the Privacy Act of 1974 was not requested except in instances when parents signed a release granting permission for this information to be reviewed. Unfortunately, many parents would not have personal data released to the researchers and when permission was granted the data was often incomplete. Hence, IQ scores, reading scores, et.al. were not considered in the analyses of the data. (Initially, achievement data was to be used in the various analyses of the data.) At the time that this study was completed it was evident that the implications of the Privacy Act of 1974 have yet to be fully realized in terms of classroom research involving researchers for whom school districts must authorize the release of protected information.

Equipment Used in the Study

Only a limited amount of equipment was needed to conduct the study. A Wollensak Model AV 2551 cassette tape player-recorder was used for the audio presentations. The audio equipment were arranged in each classroom in a manner which provided for optimum listening by the students, but at the same time created the least disruption to the customary arrangements within each classroom.

Research Design for Sub-study 1

Sub-study 1 used a pretest/posttest design without a control group as depicted in Figure 7. There was nothing to gain in

Figure 7

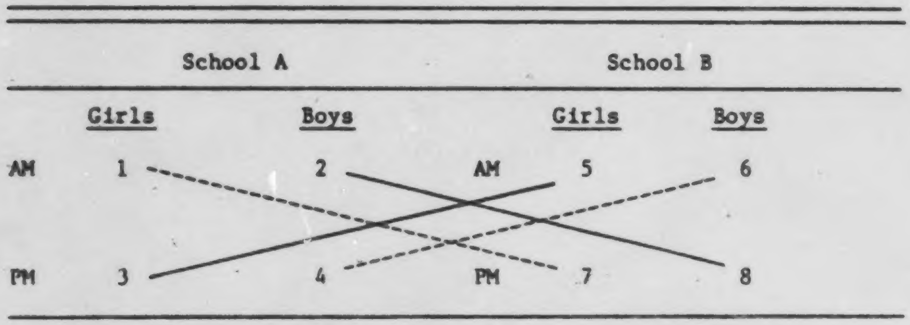
Research Design for Sub-Study 1

Group	Pretest	Treatment	Posttest
1	0	Lecture with Overhead Transparencies	0
2	0	Programmed Booklets	0

this case through the use of a control group. The purpose of the study was to determine whether various groups of students (Anglo-Americans, Blacks, and Mexican-Americans) performed similarly when instructed in a lecture with overhead transparencies mode or when self-instructed using individual programmed booklets. Variance was partially controlled by assigning classes of disadvantaged students with similar characteristics to the treatment conditions as depicted in Figure 8.

Figure 8

Assignment Strategy for Sub-Study 1



Programmed Instruction ———

Lecture with Overheads -------

Research Design for Sub-Studies 2 & 3

Sub-Studies 2 and 3 consisted of a pretest/posttest no control group design and a comparison between performance scores in English and Spanish as depicted in Figure 9.

Figure 9

Research Design for Sub-Studies 2 and 3

Group	Pretest	Treatment	Posttest
1	0	Instruction in English	0
2	0	Instruction in Spanish	0

Students in both sub-studies were randomly assigned to the treatment conditions. These sub-studies were carried out in order to compare the performance of Mexican-American vocational students instructed in Spanish with the performance levels of similar students who received instruction in English.

Research Design for Sub-Study 4

Sub-study 4 consisted of a pretest/posttest no control group design with comparisons across three groups. Participants were randomly assigned to the three treatment groups. The design is graphically portrayed in Figure 10.

Figure 10

Research Design for Sub-Study 4

Group	Pretest	Treatment	Posttest
1	0	Instructions in English	0
2	0	Instructions in Spanish	0
3	0	Instructions in English/ Spanish	0

This study was carried out to compare the performance levels of Mexican-American students in English, Spanish, and a combined English/Spanish treatment condition.

Research Design for Sub-Studies 5 & 6

A pretest/posttest no control group design was used to compare the performance of students instructed in Spanish or English but tested at different levels of complexity. The research design for these sub-studies is graphically depicted in Figure 11.

Figure 11

Research Design for Sub-Studies 5 & 6

Group	Pretest	Treatment	Posttest
1	0	Single Component Questions	0
2	0	Multiple Component Questions	0

The purpose of these sub-studies was to determine if bilingual students instructed in Spanish or English are able to formulate complex associations in a concept acquisition task.

Research Design for Sub-Studies 7 & 8

Sub-studies 7 and 8 consisted of a pretest/posttest no control design to assess the influence on student performance of three variable speech rates. The studies were similar except one study involved senior high vocational students while the second study involved junior high school students. The design for the studies is graphically presented in Figure 12.

Figure 12

Research Design for Sub-Studies 7 and 8

Group	Pretest	Treatment	Posttest
1	0	90 WPM*	0
2	0	150 WPM	0
3	0	225 WPM	0

*WPM:Words per minute

Numerous studies have shown that time compressed speech can assist persons who need review information. Time expanded speech on the other hand has been effective with certain groups of students who need supplemental instruction. This sub-study, therefore, asked the question: do bilingual students respond in the same manner to variable speech rates?

Research Design for Sub-Study 9

The final sub-study compared the performance of bilingual students who were instructed in different ways. One group was given a lecture which consisted of reading a script. It was identical, therefore, to the recorded transcriptions except it was a live presentation rather than a mechanical one. The second experimental group also received a lecture, but in this instance the lecturer included verbal analogies, illustrations, and special emphasis techniques. The groups were tested at two levels - simple and compound associations. The research design for this sub-study is portrayed in Figure 13.

Figure 13.

Research Design for Sub-Study 9

Treatment	Level	Pretest	Posttest
Embellished Lecture	Single component Questions	0	0
	Multiple component Questions	0	0
Non-embellished Lecture	Single component Questions	0	0
	Multiple component Questions	0	0

Internal Validity

In an endeavor to ensure that the treatments were the cause of changes in student performance, attention was directed to certain extraneous variables in order to minimize or eliminate their effects within the experimental design, and thereby improve the internal validity of the design.

The random assignment of subjects to sample groups and the subsequent random allocation of these groups to treatment levels provided a measure of control against statistical regression. Random assignment also protected against the differential selection of subjects and effectively guarded against having one group with a higher entry level performance than other groups. The use of change scores provided a further safeguard against the effects of one group having a higher entry level performance than the other groups. Change scores in effect covaried any difference that may have existed at the entry point.

Random assignment helped to distribute randomly those students who had higher or lower intelligence, or greater motivation to succeed on the tests.

External Validity

The random assignment of students helped to control some of the potential confounding variables that could limit the external validity of the design. Interactive effects between the treatment and selection biases were controlled through random assignment of students.

Preparation of the Data

Data for the various sub-studies consisted of pretest and posttest responses to each test item. These responses were transferred from the response sheets to computer cards by an experienced key punch operator. The transfer of data was then double checked for accuracy by comparing student responses against the responses entered onto the data cards. This was accomplished with the use of a special display program.

Analysis of Data

The analysis of the data was performed using the AMDAHL 470 V/6 computer in the Data Processing Center at Texas A&M University. The punched output from the Veldman TESTAT program was organized so that all data for each treatment within each group formed one set. For each student, the order of arrangement of the data cards for the computer was pretest followed by the posttest.

The data were then processed using various Veldman programs modified by D. G. Barker for the AMDAHL 470 V/6 computer at the Data Processing Center. The print-out for the change scores from this program contained, for each dependent variable, a main summary table for the analysis of variance, in which was displayed the treatment main effects.

If significant differences beyond the .10 level were shown for either group or treatment main effects, a Scheffé multiple comparison test was applied to the means and the results were reported on the computer print-out.

In accordance with practice identified in the literature, a $p < .05$ indicated statistical significance. Because of the uneven number of students in several of the groups, a test for the homogeneity of variance was conducted to determine whether or not a violation of this assumption of the analysis of variance had occurred.

CHAPTER 4

RESULTS OF THE RESEARCH

The fundamental purpose of this research was to determine the influence of bilingualism on vocational concept acquisition. To accomplish the purpose of the study, a series of related sub-studies were carried out in different geographical areas in which Mexican-American students were enrolled in vocational education classes. Each sub-study reported here was conducted to answer a specific research question. The results of the various sub-studies are presented in this chapter.

Sub-Study 1: The Effect on Concept Formation of Two Presentation Modes

Sub-study 1 involved three groups of disadvantaged students - Blacks, Mexican-Americans, and Anglo-Americans. The study was conducted in a high school located in Central Texas where the ethnic breakdown was approximately 5% Mexican-American, 25% Blacks, and 70% Anglo-American. Although a small percentage of Mexican-American students were enrolled, the director of vocational education for the district expressed a desire to know if these students responded in the same way as nonbilingual students to two instructional modes, one which depended largely on auditory reception and one which relied predominantly on visual skills and reading level.

Students were selected from vocational classes for the disadvantaged and assigned by in-tact classes to the two treatments. Classes were matched in such a way as to randomly distribute as many student ability levels as possible to each treatment. Consequently, the two treatment groups were very similar in terms of mean reading achievement, math achievement, and IQ. This comparison is depicted in Table 1.

Table 1

Comparison of Treatment Groups According to Selected Student Characteristics

Group	IQ	Reading Achievement	Math Achievement
Lecture with Overhead Format	83.7	6.11	6.25
Programmed Booklet Format	86.9	6.16	6.09

Except for a non-signficant difference of 3 points in mean IQ score, the groups were very well matched. The mean pretest, posttest and gain scores for the three ethnic groups are presented in Table 2.

Table 2

Mean Pretest, Posttest, and Gain Scores for Three Ethnic Groups Across Two Instructional Formats

Ethnic Group		Treatment Condition	
		Programmed Booklet	Lecture with Overhead
Anglo American	Pretest	19.1	23.9
	Posttest	33.5	38.3
	Gain Score	14.8	14.5
	N	22	21
Mexican American	Pretest	14.5	16.7
	Posttest	27.2	37.8
	Gain Score	12.7	21.2
	N	5	6
Blacks	Pretest	12.0	16.9
	Posttest	29.9	33.2
	Gain Score	16.1	16.3
	N	20	18

In terms of gain scores, the Mexican-American students were the only ones who performed significantly better in one treatment condition than in the other condition. The Mexican-American students scored approximately 10 gain score points higher in the lecture format than in the independent reading format. The other ethnic groups scored almost identically in the two treatment conditions in terms of gain scores. Despite the small number of Mexican-American students involved in the study, the study confirmed what the district's vocational director had observed many times: that Mexican-American students were hindered when required to learn vocational concepts through independent reading activities. On the other hand, when instructed in a clear, precise lecture format this group of students performed as well as any group.

Sub-Study 2: The Effects of English Versus Spanish on Vocational Concept Formation

Sub-study 2 served as a pilot test of the Spanish materials. The valve materials had been previously field tested. However, the field test was completed only in English. Sub-study 2, therefore, was devised to test whether the Spanish recordings were of an acceptable quality to use in the research. Bilingual students from a private academy were granted permission to participate in the pilot study. The students were randomly assigned to groups and the groups in turn were randomly assigned to the treatments. The means and standard deviations for the groups are presented in Table 3.

Table 3

Means and Standard Deviations Across
Two Treatment Conditions: English and Spanish

Condition		Pretest	Posttest	Gain Score
English	$\overline{X}$	12.29	34.43	22.14
	SD	4.61	6.85	8.45
	N	7	7	7
Spanish	$\overline{X}$	10.00	20.60	10.60
	SD	5.48	11.67	9.38
	N	10	10	10

The mean gain scores show that learning took place in each treatment. There was a gain score of approximately 22 points for the English treatment and 11 points for the Spanish treatment. The mean scores were then compared between the two treatment groups to see if there were significant differences. Veldman's program Anscheff was used in the comparison, the results of which are presented in Table 4.

Table 4

Analysis of Variance Across Pretest, Posttest, and Gain Scores for Individuals Assigned to English versus Spanish Instruction

Test	Analysis of Variance				
	SV	DF	MS	F	P
Pretest	Total	16	26.18		
	Groups	1	21.51	0.312	0.385
	Error	15	26.50		
Posttest	Total	16	143.35		
	Groups	1	787.41	7.34	0.013
	Error	15	100.40		
Gain Scores	Total	16	110.62		
	Groups	1	548.62	5.74	0.019
	Error	15	81.42		

From the outcomes of the pilot study, it can be seen that bilingual students instructed in English performed significantly better than students who were instructed in Spanish. Although the students involved in the study spoke Spanish regularly with their peers and in their homes, their performance in this particular concept acquisition task was greater in English than it was in Spanish. On the pretest, the groups did not differ, but the groups differed significantly on the posttest ($p < .01$). They also differed significantly in terms of concept acquisition (gain scores) ($p < .02$).

Sub-Study 3: The Effects of English Versus Spanish on Vocational Concept Formation

Sub-study 3 was similar to sub-study 2 except for a larger group of participants. The students were selected from a rural school district in which approximately 30% of the student body spoke Spanish as the predominant language in the home and with peers. The students were selected from several different vocational classes and randomly assigned to two groups. The groups were then randomly assigned to the two treatments. The groups were excused from classes and reported to designated rooms where the study was conducted. The groups were administered a pretest and approximately one week later were given instruction in either English or Spanish and then posttested. The means and standard deviations for the two tests and the gain scores are presented in Table 5.

Table 5

Means and Standard Deviations Across
Two Treatment Conditons

Condition		Pretest	Posttest	Gain Score
Spanish	$\bar{X}$	7.94	11.75	3.81
	SD	3.13	8.68	9.24
	N	16	16	16
English	$\bar{X}$	7.77	26.77	19.0
	SD	4.04	11.53	9.33
	N	17	17	17

The groups performed nearly identically on the pretest, but instruction in English effected gain scores more than instructions given in Spanish. The gain score for the Spanish group was less than 4 points while the gain score for the group instructed in English was close to 20 points. An analysis of variance was performed to determine the level of significance of these differences, the results of which are shown in Table 6.

Table 6

Annalysis of Variance Across Pretests,
Posttests, and Gain Scores for Individuals
Assigned to English Versus Spanish Instruction

Test	SV	DF	Analysis of Variance		
			MS	F	P
Pretest	Total	32	12.76		
	Group	1	0.25	0.019	0.8872
	Error	31	13.16		
Posttest	Total	32	159.76		
	Group	1	1858.18	17.70	0.0004
	Error	31	104.97		
Gain Score	Total	32	142.99		
	Group	1	1901.20	22.04	0.0002
	Error	31	86.27		

The analysis of variance indicated that there were highly significant differences in the performances of the two groups in terms of posttest scores and gain scores. The outcomes in the main study were very similar to those in the pilot study; both experimental groups receiving instruction in English performed significantly better than the groups who received instruction in Spanish.

Sub-Study 4: The Effects of English, Spanish, and Combined English and Spanish on Vocational Concept Formation

Sub-study 4 was conducted in a school in which Spanish-speaking students comprised more than 50% of the student body. The performance of bilingual students was compared across three treatment conditions-English, Spanish, and a combined English/Spanish format.

Students were randomly assigned to the three groups and the groups in turn were randomly assigned to the three treatment conditions. The means and standard deviations for the three treatment conditions are listed in Table 7.

Table 7

Means and Standard Deviations for Three Treatment Conditions: English, Spanish, and Spanish/English Combination

Treatment		Pretest	Posttest	Gain Score
English	$\bar{X}$	13.69	22.59	8.13
	SD	8.12	15.32	9.79
	N	13	13	13
Spanish	$\bar{X}$	8.46	17.31	8.85
	SD	4.26	11.13	10.52
	N	13	13	13
Spanish/English Combined	$\bar{X}$	10.72	26.00	15.21
	SD	5.97	13.08	12.00
	N	11	11	11

In this sub-study, the students who received instruction in Spanish or in English performed equally well in terms of gain scores. The group receiving instruction in a combined English/Spanish format had a gain score which was approximately 7 points greater than that for the other groups. An analysis of variance was then performed to determine if the differences in mean gain scores were significant. The results of this analysis are presented in Table 8.

Table 8

Analysis of Variance of Performance
Mean Scores Across Three Treatment Conditions

Test	SV	DF	MS	F	P
Pretest	Total	36	42.81		
	Group	2	89.40	2.23	0.12
	Error	34	40.06		
Posttest	Total	36	185.29		
	Group	2	233.37	1.28	0.29
	Error	34	182.46		
Gain Score	Total	36	124.94		
	Group	2	155.90	1.27	0.30
	Error	34	123.11		

(MS, F and P under the spanning header "Analysis of Variance")

The analysis of variance for the pretest, posttest, and gain scores indicated that there were no significant differences between the treatment groups. The mean gain score for the combined English/Spanish treatment was higher but not significantly higher.

The combined Spanish/English format test was given in both Spanish and English. The instruction was also given in both languages - part in Spanish and part in English. The other groups received equivalent instruction but only in Spanish or in English.

Sub-Study 5

Sub-study 5 sought to determine the extent to which bilingual students could make complex associations when instructed in Spanish. The students who participated in the study were given identical instruction in the identification of 3 valve symbols, 3 joint symbols, and 2 pipe function symbols. The students were then tested to determine concept acquisition. Two test forms were used. One form required the students to respond to simple questions and another form required students to make compound associations. The means and standard deviations for sub-study 5 are presented in Table 9.

Table 9

Means and Standard Deviations for Pretest, Posttest, and Gain Scores for Bilingual Students

Group		Pretest	Posttest	Gain Score
Simple Questions (Single concept)	$\bar{X}$	8.57	14.43	5.86
	SD	3.35	13.94	12.80
	N	14	14	14
Compound Questions (Multiple concepts)	$\bar{X}$	7.64	23.64	16.00
	SD	3.14	13.09	13.32
	N	11	11	11

The pretest performance of the two treatment groups did not differ between the groups. There appeared to be a significant spread in the group differences between the mean scores for the posttest and for the gain score; therefore, an analysis of variance was performed to determine whether the observed differences were statistically significant. The outcomes of the analysis of variance are included in Table 10.

Table 10

Analysis of Variance for Two Test Forms

Test		Analysis of Variance			
	SV	DF	MS	F	P
Pretest	Total	24	10.39		
	Group	1	5.39	0.51	0.51
	Error	23	10.61		
Posttest	Total	24	198.43		
	Group	1	522.27	2.83	0.10
	Error	23	184.37		
Gain Score	Total	24	189.14		
	Group	1	633.73	3.73	0.06
	Error	23	169.81		

The group which received the complex test form scored nearly 10 points more than the group which received the simplified test form; however, the difference was not statistically significant.

Sub-Study 6

Sub-study 6 had the same purpose as sub-study 5 except in this sub-study instruction was given in English. Students who participated in the study (which was conducted in a high school with approximately 30 percent Mexican-American enrollment) were randomly assigned to two groups. The groups then were randomly assigned to the two test forms, the simplified form and the complex form. The means and standard deviations for the pretest, posttest, and gain scores are included in Table 11.

Table 11

Means and Standard Deviations for Pretest,
Posttest, and Gain Scores for Two Test Forms

Condition		Pretest	Posttest	Gain Score
Complex Form	$\overline{X}$	10.15	31.46	21.31
	SD	3.18	9.81	9.89
	N	13	13	13
Simple Form	$\overline{X}$	10.63	10.13	-0.50
	SD	4.15	7.59	8.04
	N	16	16	2.01

The pretest performances of the two groups were almost identical. The posttest and gain score differences were much greater. Therefore, analysis of various was performed to determine if the differences were significant. The analysis of variance is shown in Table 12.

Table 12

Analysis of Variance for Two Groups Across
Pretest, Posttest, and Gain Scores for Two Test Forms

Test			Analysis of Variance		
	SV	DF	MS	F	P
Pretest	Total	28	13.61		
	Group	1	1.59	0.113	0.74
	Error	27	14.05		
Posttest	Total	28	188.72		
	Group	1	3265.22	43.66	0.00
	Error	27	74.78		
Gain Score	Total	28	198.35		
	Group	1	3411.02	42.98	0.00
	Error	27	79.36		

There were significant differences in the two groups on the posttest. The differences between the two groups also applied to the gain scores. In both Spanish and in English, the students scored higher on the test forms which tested acquisition of complex concepts than on test forms which assessed the acquisition of simple concepts.

Sub-Study 7: The Effects of Variable Speech Rates On Vocational Concept Acquisition for Disadvantaged, Bilingual Students

Sub-study 7 compared the performance of bilingual vocational students across three speech rates 90 words per minute (WPM), 150 WPM, and 225 WPM. All instruction was given in Spanish. The study was carried out in a junior high school with about a 90% enrollment of Mexican-American students. The students who participated in the study were classified as disadvantaged students and were enrolled in special vocational classes for the disadvantaged. To be so classified, students must be two years below grade level in at least two basic skills areas.

The students were randomly assigned to two groups, and the two groups were randomly assigned to the treatment conditions. The means and standard deviations for the groups are presented in Table 13.

Table 13

Means and Standard Deviations for Three
Variable Speech Rates in a Concept Acquisition Task

Treatment Group		Pretest	Posttest	Gain Score
90 WPM	$\overline{X}$	9.00	13.62	4.62
	SD	3.94	4.94	6.54
	N	13	13	13
150 WPM	$\overline{X}$	10.08	19.08	9.00
	SD	4.46	11.92	10.71
	N	12	12	12
225 WPM	$\overline{X}$	9.79	10.21	0.43
	SD	3.47	6.50	7.48
	N	14	14	14

Pretest scores for the three groups were very similar. The differences in posttests and gain scores seemed sufficiently wide spread to perform an analysis of variance. The results of the single classification analysis of variance are presented in Table 14.

Table 14

Analysis of Variance for Three Speech Rates Across
Prettest, Posttest, and Gain Scores

Test	Analysis of Variance				
	SV	DF	MS	F	P
Pretest	Total	38	14.98		
	Group	2	3.98	0.255	0.7
	Error	36	15.59		
Posttest	Total	38	76.76		
	Group	2	256.21	3.33	0.03
	Error	36	66.79		
Gain Score	Total	38	78.36		
	Group	2	237.69	3.42	0.04
	Error	36	69.61		

No significant differences were noted in the performance of the groups on the pretest. There were significant differences, however, for the posttest and the gain scores. To further analyze these differences, a Scheffé test was completed for the posttest and the gain scores, the results of which are presented in Table 15.

Table 15

Scheffé Comparison of Group Means for Posttest and Gain Scores

Test	Comparison		DF	DIFF	F	P
Posttest	GRP1 GRP2	2	36	-5.47	1.40	0.26
	GRP1 GRP3	2	36	3.40	0.58	0.57
	GRP2 GRP3	2	36	8.87	3.81	0.03
Gain Score	GRP1 GRP2	2	36	-4.39	0.86	0.43
	GRP1 GRP3	2	36	4.19	0.85	0.43
	GRP2 GRP3	2	36	8.57	3.42	0.04

Scheffé comparisons of group means revealed no significant differences between the group means for treatment 1 (90 WPM) and treatment 2 (150 WPM) or for treatment 1 (90 WPM) and treatment 3 (225 WPM). The only significant difference was between treatment 2 (150 WPM) and treatment 3 (225 WPM). The largest gain scores and posttest scores were associated with Treatment 2 (150 WPM) which is the normal speech rate.

Sub-Study 8: The Effects of Variable Speech Rates on Vocational Concept Acquisition for Non-disadvantaged Bilingual

Sub-study 8 compared the performance of bilingual, non-disadvantaged students across three speech rates, 90 WPM, 150 WPM, and 225 WPM. Instruction was given in Spanish to all groups, the only variable which was intentionally varied was the rate of speech.

The study was carried out in a school with approximately 90% Mexican-American enrollment. The students who participated in the study were selected from regular vocational classes and were randomly assigned to two groups which in turn were randomly assigned to the three treatment conditions. The means and standard deviations for the three groups across pretest, posttest, and gain scores are listed in Table 16.

Table 16

Means and Standard Deviations for Three Treatment Groups in a Concept Acquisition Task

Treatment Group		Pretest	Posttest	Gain Score
90 WPM	$\overline{X}$	10.00	27.33	17.33
	SD	6.82	8.70	10.09
	N	9	9	9
150 WPM	$\overline{X}$	12.33	20.00	7.67
	SD	7.50	9.45	10.10
	N	12	12	12
225 WPM	$\overline{X}$	11.64	20.50	8.86
	SD	4.53	12.90	10.56
	N	14	14	14

Pretest scores for the three groups differed by 2 points. Posttest scores differed by a greater amount so an analysis of variance was performed to determine if the differences were significant. The results of the analysis of variance are presented in Table 17.

Table 17

Analysis of Variance for Three Variable Speech Rates Across Pretest, Posttest, and Gain Scores

Test	Analysis of Variance				
	SV	DF	MS	F	P
Pretest	Total	34	37.84		
	Group	2	14.40	0.37	0.70
	Error	32	39.31		
Posttest	Total	34	120.14		
	Group	2	167.62	1.43	0.25
	Error	32	117.17		
Gain Score	Total	34	115.89		
	Group	2	276.89	2.61	0.09
	Error	32	105.83		

The analysis of variance revealed no significant differences between the group means at the .05 level. Differences in group means on the gain scores approached significance with the greatest difference occuring between treatment 1 (90 WPM) and treatment 2 (150 WPM) and treatment 1 (90 WPM) and treatment 3 (255 WPM). There was no clear cut superiority for any of the variable speech rates, but a trend was detected toward the superiority of the lowest speech rate.

Sub-Study 9: The Effects on Vocational Concept Acquisition of Two Lecture Formats

Sub-study 9 was carried out to determine the effects of two lecture formats on a vocational concept formation task for bilingual students. In one lecture format, the English script from which recordings had been made was read as a lecture to a group of students. In the second lecture format, the same script was followed but verbal embellishments were added - analogies were included in the presentation and vocal emphasis was given to content of primary importance. This lecture was less rigid and more student centered than the format in which the script was read as a formal lecture.

All of the students who participated in the study were bilingual. The school where the study was carried out was about 40% Mexican-American. The students for the study were randomly assigned to four groups, and the four groups were randomly assigned to two treatment conditions and further sub-assigned to two test forms, either simple or complex. The means and standard deviations for the various groups are presented in Table 18.

Table 18

Means and Standard Deviations Across Pretest, Posttest, and Gain Scores for Two Lecture Formats

Treatment	Test Form		Pretest	Posttest	Gain Score
Lecture with Analogies	Complex Form	$\bar{X}$	8.14	29.71	21.36
		SD	1.88	13.25	13.50
		N	14	14	14
	Simple Form	$\bar{X}$	12.71	35.36	22.64
		SD	7.99	3.82	7.06
		N	14	14	14
Lecture from Script	Complex Form	$\bar{X}$	9.40	24.60	15.20
		SD	2.32	12.14	12.66
		N	15	15	15
	Simple Form	$\bar{X}$	9.36	30.00	20.64
		SD	3.20	11.54	10.15
		N	14	14	14

Pretest scores showed very little variability across the two treatment conditions or test forms. There was greater variability among posttest and gain scores, so a 2 x 2 factorial analysis of variance was performed to detect whether these differences were significant. The results of the analysis of variance are given in Table 19.

Table 19

Analysis of Variance Across Two Test Forms and Treatment Conditions

Test	Analysis of Variance				
	SV	DF	MS	F	P
Pretest	Total	56	22.32		
	Between	3	54.83		
	A	1	15.70	0.77	0.61
	B	1	73.00	3.57	0.06
	AB	1	75.78	3.70	0.06
	Within	53	20.48		
Posttest	Total	56	126.61		
	Between	3	274.85		
	A	1	390.26	3.30	0.07
	B	1	434.05	3.67	0.06
	AB	1	0.23	0.002	0.96
	Within	53	118.22		
Gain Score	Total	56	126.03		
	Between	3	153.16		
	A	1	236.84	1.91	0.17
	B	1	161.15	1.30	0.26
	AB	1	61.50	0.49	0.51
	Within	53	124.49		

None of the main effects or the interactions was significant although several of them approached significance. In all instances in which the main effects approached significance, the simple effects were compared with t tests. These means too approached differences that were significant but fell short of the .05 level. Definite trends were detected, however. On the posttest scores, the treatments and test forms both were less than .01 from being significantly different.

Conclusion

Originally, studies had been planned which examined the effects of Spanish labels on concept formation since several studies have shown that labels in English assist English-speaking students to acquire concepts. Materials were prepared with Spanish labels and a brief pilot test was planned. However, it was learned that the Spanish students who were to participate in the study could not read Spanish except at the most elementary level, certainly not at a level involving a technical vocabulary. The study was to be conducted in a school with a high concentration of Mexican-American students, but the leaders of the school requested that the study not be conducted because the students would not be able to read the Spanish materials. We found this to be true everywhere that we were permitted to conduct our sub-studies. Only a small minority of Mexican-American students, we were repeatedly told, are capable of reading Spanish to the extent that they would benefit from reading technical material in Spanish. Many Mexican-American students have limited reading ability in either English or in Spanish. The application and implications of the data presented in this chapter are discussed in Chapter Five.

CHAPTER 5

IMPLICATIONS OF THE STUDY

In this study, selected variables were examined to determine their influence on the vocational concept acquisition of bilingual students. The purpose of the study was to gain insights into effective strategies for teaching vocational concepts to students of limited English-speaking ability.

The Education Amendments of 1976 and Technical Amendments of 1977 earmark an unprecedented amount of federal funds to bilingual vocational education. In Fiscal Year 1977, for example, 60 million dollars of discretionary funds will be expended on the development of bilingual vocational programs. In addition there will be funds available for bilingual vocational education under other sections of the Act. There are many factors, however, which will seriously hinder the effectiveness of bilingual vocational programs. First, there is not an acceptable definition of bilingual vocational education nor are there clearly stated purposes for bilingual vocational programs.

Some consider the purpose of bilingual vocational programs to prepare students to function "vocationally" in two languages. The bilingual secretarial training programs in Brownsville, Texas are representative of this interpretation of bilingual vocational education. Some think of bilingual vocational programs as those in which students are taught the names of technical terms and trade processes in two languages, enabling the trainee to work in industries where a language other than English is used and giving the trainee assurance that his native language is regarded as an important part of the local culture. Others consider bilingual vocational programs to be remedial in nature, to assist the limited English-speaking to receive vocational instruction in their predominant language (a language other than English). There are very few of these programs at the secondary level but several of them have been established at the post secondary level. These programs resemble manpower development programs in many ways. Federal legislation dealing with bilingual vocational programs focuses primarily on the needs of the limited English-speaking, because this group is vulnerable to high rates of unemployment and underemployment. A major problem at this time, however, is the lack of clearly defined goals for bilingual vocational programs.

Although there is a substantial commitment of federal dollars to bilingual vocational education, there are no clearly defined outcomes to be achieved through the use of these funds. Until clearly defined goals and definitions are available, the long term impact of research, personnel development, program innovation, and curriculum development will continue to be "hit or miss". This research attempted to establish whether instruction of bilingual students, many of whom were of limited English-speaking ability, benefit significantly more from instruction in Spanish than from instruction in English. In one sense, the research was an attempt to determine if the instructional materials that are being translated from English to Spanish (and other languages) will significantly improve instruction for limited English-speaking students or will end up as stock piles of largely unused shelf material. Further, the research sought to determine the influence on concept learning of variables that can be manipulated under normal instructional conditions.

Implications of Sub-Study 1

If bilingual vocational programs are to focus on the needs of persons with limited English-speaking ability, then it is imperative to know the effect that various instructional approaches have on the vocational concept learning of bilingual students. Sub-study 1 was carried out in a community in which Mexican-Americans comprised about 10% of the total school enrollment. This percentage is typcial of many communities in Texas. Nevertheless, this is a very significant number of students when one considers the hundreds of communities which have approximately this number of bilingual students enrolled, many of who have limted English-speaking ability.

The study compared the performance of disadvantaged bilingual students (two years below grade level in reading and one other basic skill area) in two instructional arrangements, a group lecture with overhead transparencies and an independent reading format. Visual illustrations for the two groups were identical, and the scripts contained the same information though the written material was modified slightly in order for the material to be contained in the programmed booklets.

The performance of three ethnic groups in the two instructional arrangements was studied. In terms of gain scores, Anglo-Americans performed almost identically in both instructional formats. Blacks also performed as well in one format as the other. The Mexican-American students, however, performed significantly better in the lecture with overhead transparencies arrangement than in the programmed booklet which was read independently. The implications of this outcome must be considered in light of the small number of Hispanic students who participated in the study. However, the percentage of Mexican-American students in this study is repeated in hundreds of communities and, therefore, should not be overlooked in bilingual research within the context in which these students participate daily in educational settings. It was found that these students do not perform as well in circumstances which require independent reading as in circumstances in which concepts are presented in a very direct and clear manner. The Mexican-American students scored several points less than the Anglo-American students in the independent reading arrangement but scored equally well as the Anglo-American students in the active lecture format.

Teachers need to be cognizant of the effects on learning of activities which require reading. Reading exams independently may significantly impede the performance of Mexican-American students especially those who are below grade level in reading as were all of the students who participated in this study. It is important to recognize, too, that the lecture given in this study had clearly illustrated visuals and was very clear and direct in the information presented. In this study, students with limited English-speaking ability benefited significantly from the instruction that was very direct, that repeatedly emphasized critical properties of the concepts being taught, and that allowed the students to practice what was being learned prior to final assessment.

Implications of Sub-Studies 2 and 3

Sub-studies 2 and 3 were identical except they were carried out in different communities. All the students who participated in the studies were Mexican-American. Many of them were experiencing trouble in high school. (As pointed out in Chapter 1, more than one half of the Mexican-American students in Texas fail to complete high school.)

In the school in which the main study took place (Sub-study 2 was a pilot study), Mexican-Americans represented about 25% of the school population. The vocational director for the school indicated the Mexican-American students predominantly spoke

Spanish with their Mexican-American peers but preferred to be instructed in English in the school setting. The performance of the students reflected this preference. In both schools, the groups which were instructed in English scored significantly higher on posttests than did the Spanish instructed group. The groups tested the same on the pretest which indicated that they were about equal in previous knowledge of the subject matter.

The implications are rather straight forward for the two sub-studies. Mexican-American students may be hindered rather than helped by instruction in Spanish. The study can be replicated with the materials provided in this final report. In some communities, the outcomes may favor Spanish materials, but in many communities it is likely that English instruction will be superior. This is the language that many of the Mexican-American students prefer for instructional purposes, possibly because it is less segregational than Spanish instruction would be.

Implications of Sub-Study 4

Sub-study 4 was carried out in a school in which Mexican-Americans comprised the majority of the school population, followed by Blacks and a small percentage of Anglo-Americans. Randomly selected groups of Mexican-American students were assigned to three different language conditions: instruction in English, Spanish, and a combination of English and Spanish. There were no significant differences between the groups in terms of pretest, posttest, or gain scores. The highest gain score was obtained by the group which received a combination of Spanish/English instruction.

Upon completion of the study, the students were asked their preference of language for instructional purposes. Virtually all of the students expressed a strong preference for instruction in English. The expression of preference for English instruction and the failure of Spanish instruction to result in significantly greater learning imply that additional research is needed before millions of dollars of bilingual vocational funds are expended on the development of programs and materials which in fact may have only minimal if any effect on the improvement of learning of persons who have limited English-speaking ability.

It should be pointed out that the materials used in this sub-study (metal threaded fasteners) differed from the materials used in sub-studies 2 and 3 (plumbing symbols). The groups were learning concepts to which they at least had some prior exposure whereas the sub-studies which found a superiority for English involved concepts to which the majority of the students had no prior exposure. With vaguely familiar concepts and materials, instruction in either English or Spanish may be equally effective. But in more difficult and less familiar material, instruction in English may prove effective because it is the language Mexican-American students are accustomed to for instruction and it is the language that most of them read.

Implications of Sub-Studies 5 and 6

Sub-studies 5 and 6 dealt only with one language. Instruction in sub-study 5 was given entirely in Spanish and instruction in sub-study 6 was given in English. The purpose of the two studies was to investigate the extent to which Spanish-speaking students differed on two test forms. One test form asked single concept questions. Examples of these questions are: (1) "select the gate valve", (2) "select the valve that is connected to cold water pipes", and (3) "select the valve connected to pipes by soldered joints". The second test form asked complex questions such as (1) "select the globe valve connected to hot water pipes by soldered joints" or (2) "select the gate valve that has been threaded to a cold water pipe". To answer the first set of questions, the student needed only to have formulated a single concept. To answer the second set of questions, the respondent needed to have learned three independent concepts and the relationship of the three. The study was carried out to determine the extent to which bilingual students were able to make the complex associations. It was not possible to conduct the study in a single school so two separate studies were conducted, one in English and one in Spanish.

In the sub-study conducted in Spanish, the students assigned to the test form which had complex test questions scored higher than those given the simple test form. This order was repeated in the sub-study in which instruction was given in English. In the latter instance, there was a significant difference favoring the group which was given the complex questions.

The two sub-studies would need to be replicated before any conclusions can be made. The groups received instruction that was as identical as one can give in a non-clinical setting. Possibly the complex questions required students to attend more closely to the task at hand and hence perform better overall. Again, it could be that certain factors were overlooked by the experimenters. The exams were administered in different rooms because the questions were read to the students. There may have been factors which distracted the students, especially in the one English group which failed to show any gain score. Because the students were randomly assigned to the treatment groups, it is highly unlikely that one group had higher ability students than another.

Implications of Sub-Studies 7 and 8

Sub-studies 7 and 8 were made in schools in which Mexican-American students comprised 90% of the student body. The purpose of the studies was to determine if bilingual students are affected in the same manner by variable speech rates as non-bilingual students are. Previous studies have shown that time compressed speech does not adversely affect comprehension and has numerous advantages for individualized and group instruction because it permits more information to be covered in a set time period (Barry, 1976). Studies comparing the effects on learning of time compressed speech (rapid speech), normal speech (about 150 words per minute, WPM) and time-expanded speech (sub-normal speech rates) show no significant differences in many studies for normal and rapid speech rates with subjects of normal intelligence. Barry (1976) found no significant differences across three speech rates for disadvantaged students. One sub-study replicated Barry's previous study but was conducted in Spanish with bilingual disadvantaged students. The second sub-study replicated Barry's study but did not involve disadvantaged students.

In sub-study 7, the bilingual, disadvantaged students performed similarly on the pretest, but differed significantly on the posttest and in terms of gain scores. The normal speech rate was superior to the rapid speech rate but not superior to the slower speech rate. In sub-study 8, there were no significant differences between the groups although the gain score for the slow speech rate group was nearly 10 points higher than that for the normal and expanded rate. Unlike many of the speech rate studies conducted in English, there were no disadvantages imposed by the slow speech rate in Spanish. Nor was there a clear cut superiority for any particular speech rate. Learning took place for all rates of speech. The non-disadvantaged students obtained higher scores than the disadvantaged students at all speech rates. At some speech rates, there was a significant difference favoring the performance of the non-disadvantaged students.

The implications of these findings are that bilingual students can receive instruction using compressed speech or expanded speech when such instruction is advantageous. Disadvantaged bilingual students may benefit more, however, from normal speech rates when instruction is given in a language other than English.

Implications of Sub-Study 9

Sub-study 9 sought to determine the influence on vocational concept acquisition of two lecture styles - a formal, read lecture and a lecture covering the same materials but with analogies and vocal emphasis used to stress content of special importance. Bilingual students were instructed in English and tested at two levels of comprehension as in sub-studies 5 and 6.

The data was analyzed using a factorial analysis of variance. In terms of gain scores, there were no significant differences for main effects (treatment or test form), nor was there significant interaction. Unlike sub-studies 5 and 6, students performed equally well with both test forms with non-significant higher scores for the simple test form.

Learning was highly significant for both groups. The students in this sub-study performed much better in the live presentation arrangements than in the passive, pre-recorded arrangements which were studied in the same school district (sub-study 6) and covered identical information. Additional pre-planned comparisons are needed between live presentations and pre-recorded presentations for disadvantaged bilingual students. It would appear from this series of sub-studies that live presentations result in greater learning than the passive, pre-recorded presentations.

Conclusions of the Research

In this series of studies, two types of concepts were taught, metal threaded fasteners and plumbing symbols. In the various sub-studies involving the learning of metal threaded fasteners, there was no clear cut superiority for instruction in English or instruction in Spanish. For the sub-studies in which plumbing symbols were learned (a more abstract and complex task), there was an overall superiority for instruction in English. In both languages as instructional variables were manipulated (rate of speech, test format, etc.), learning was affected. This indicates that learning can be improved and brought up to a high criterion level provided that appropriate variables are controlled in the optimum manner.

One of the principal things that should be remembered about the outcomes of this study is that the students who participated in it came from many different regions and different population concentrations. Students from schools having a Mexican-American enrollment of 10% or less and schools having a Mexican-American enrollment of more than 90% participated in the study. The students came from rural schools and metropolitan schools. Regardless of the area of the state, however, there was no superiority for instruction in Spanish. Students from schools where Mexican-Americans represented a minority of the enrollment (predominantly the schools the greatest distance from the Mexian border) performed in Spanish less efficiently than the Spanish-speaking students from schools in which Spanish-speaking students comprised a majority of the enrollment.

Many of the students in schools where Spanish-speaking students were in the minority expressed a definite preference for instruction in English. In several instances, students were very vocal about their preference for instruction in English. Some students pointed out that only "wet backs" (illegal aliens from Mexico) needed instruction in Spanish.

Teachers were divided in their opinions about the need for bilingual instruction, but the majority of them indicated that high school age students of limited English-speaking ability are not helped much by bilingual instruction except in the case of recent immigrants who aggressively seek to learn to speak English.

Learning technical terms in a combined Spanish and English format can be accomplished and in this study was highly successful. However, many teachers and industrial persons alike indicated that technical terms (except for very common terms) often are only transliterated from one language to the other. Several of the technical terms which we translated from English to Spanish would not be translated in the same manner if the translation had been from English to Tex-Mex.

Another problem encountered in this study was the differences in dialect from one region to another. In one community, the students listened to our Spanish tapes for only moments before saying "that's the Spanish they speak in El Paso, not here". Quite so. The individual who made our tapes learned to speak Spanish in El Paso. This individual had a Ph.D. degree in Spanish (modern languages) and assured us that the dialects were somewhat superfiscial in nature but were perceptible in terms of vocal accents and so forth from one region to another. The point is: that persons who seek to translate materials from English to Spanish must consider that Spanish like English may differ in some respects from region to region. Again, this is not saying that bilingual instruction is of no use but it is one more factor that should be considered when programs to assist the limited English-speaking are being developed.

There is a definite need to assist all special needs groups to derive maximum benefit from vocational education. But to do this, there must be specific goals for activities that are undertaken. In addition there must be clearly defined problems. The high drop out rates, the high rates of unemployment and underemployment of Spanish-speaking persons constitute a definite problem. But it is not clear what the basis of the problem is, and it is certainly not known whether vocational education is the solution to these problems. Like many manpower programs for the economically disadvantaged, vocational training alone may not be sufficient to increase the quality of life (or earned income) for certain persons. This in no way implies that bilingual vocational programs are unnecessary but such programs should be realistically planned with total services - guidance and work study programs must be provided as well as specific instruction in the preferred language of the student.

Finally, this study confirmed many of the findings of previous concept learning studies which are summarized in the mini-report appended to this final project report.

Recommendations for Further Study

For persons wishing to examine the influence on concept learning of particular variables, the materials developed for this study can be used. The portions of the materials and tests which are not included in this final report can be borrowed for copying.

The interaction of traits and various instructional conditions should be studied provided that the researchers have access to student data (something that was not available or not sufficiently complete for use in this study).

For students who can read Spanish effectively, various studies could be planned. Originally, this project sought to determine the impact of labelling items in Spanish and English, but the students did not read Spanish well enough to carry out these portions of the study as planned.

Research is needed to determine the long term impact of various bilingual strategies. Also, there is a need to identify the goals of bilingual vocational education, goals which can improve the level of vocational skill acquisition for persons of limited English-speaking ability.

Research is needed to determine the long term impact of instruction that is clear, direct and based on effective principles such as those identified in the concept formation literature.

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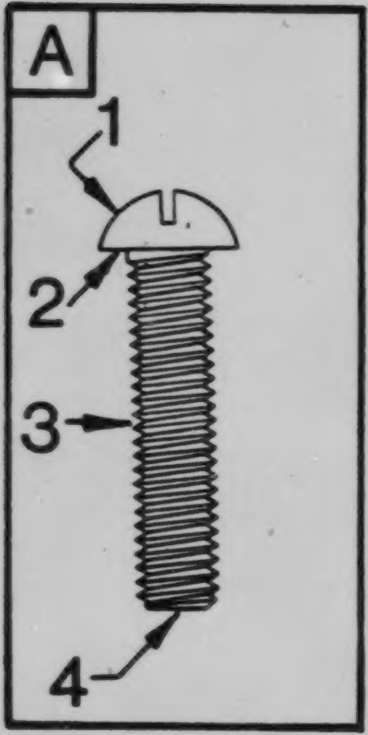
APPENDIX A

Instructional Materials Used in the Study

1. Visuals for selected screws and bolts
2. Visuals for plumbing symbols*

* Included in sleeve attached to back cover.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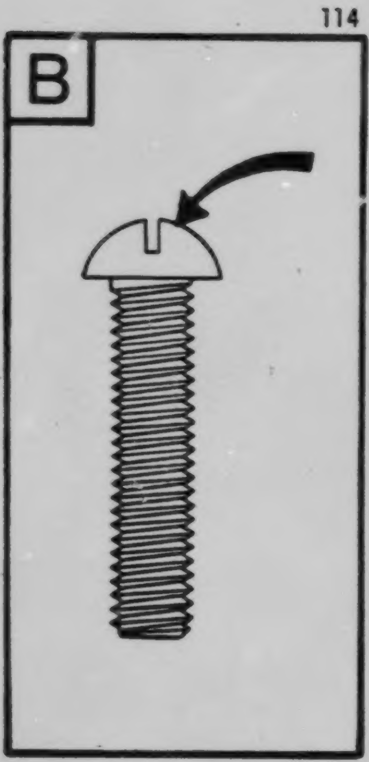
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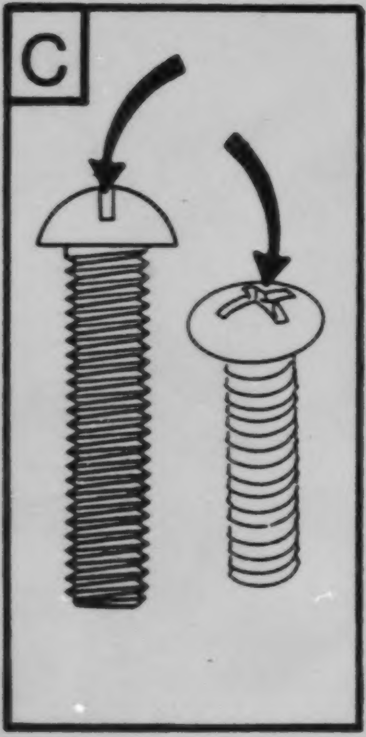
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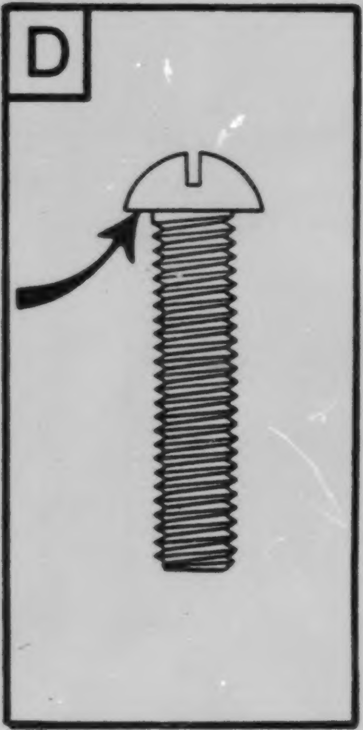
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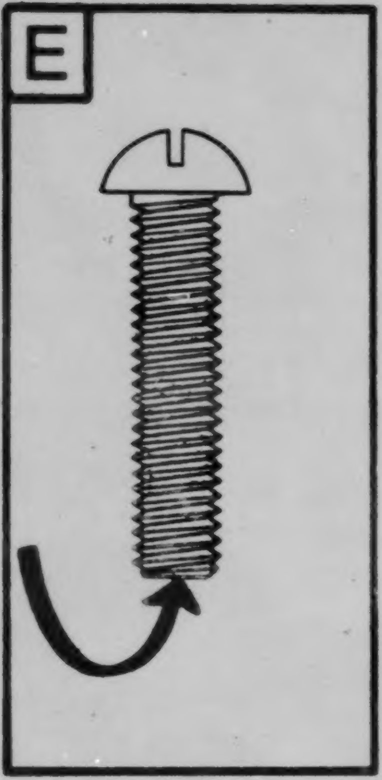
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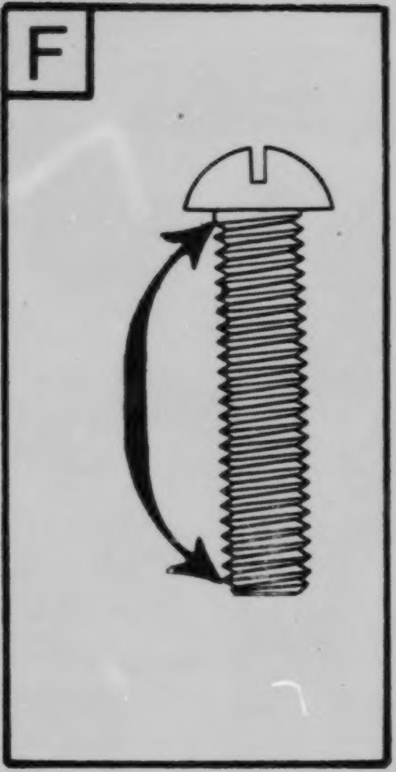
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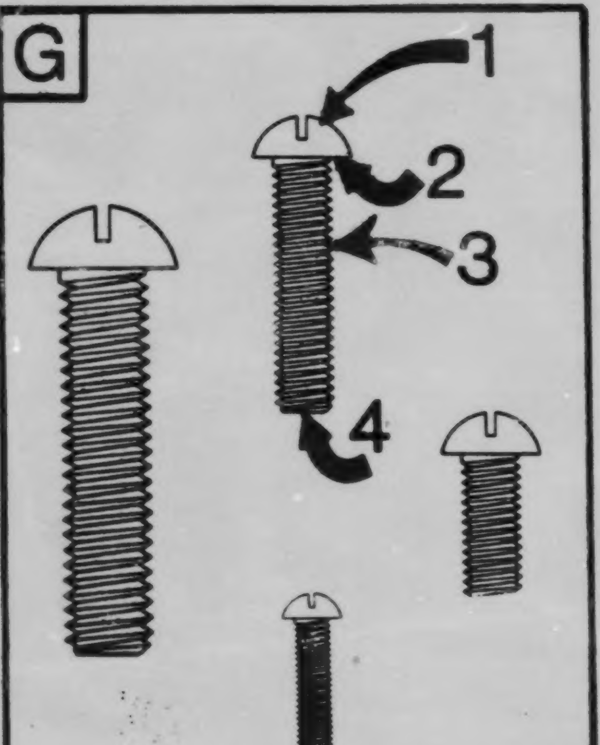
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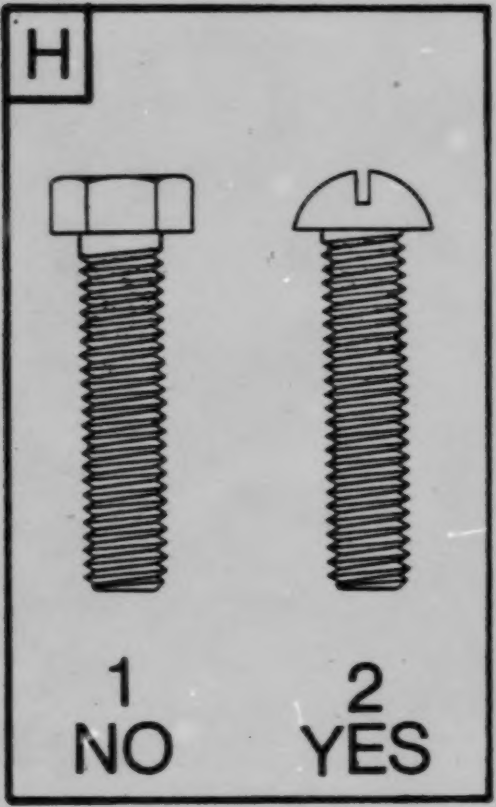
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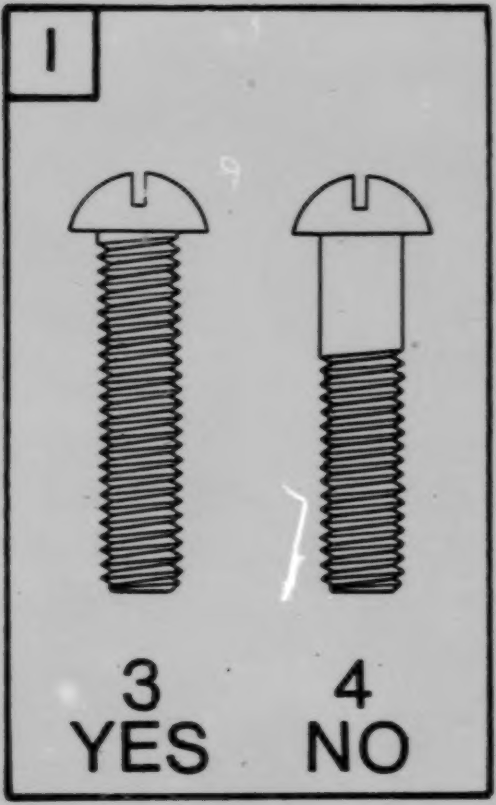
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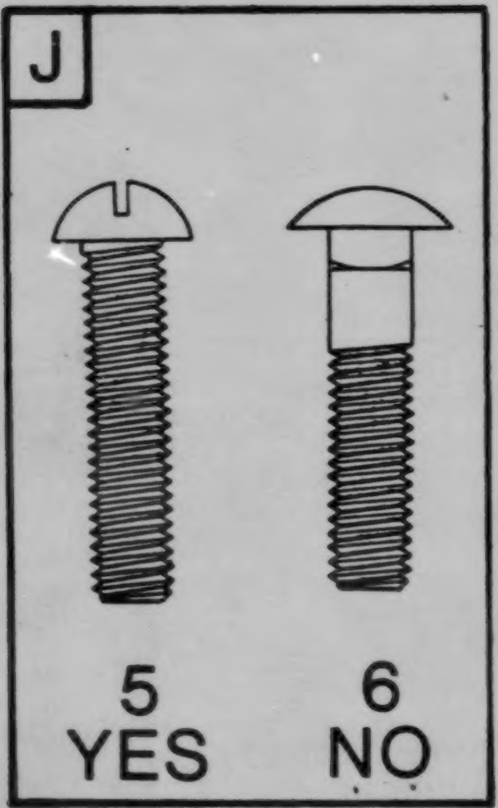
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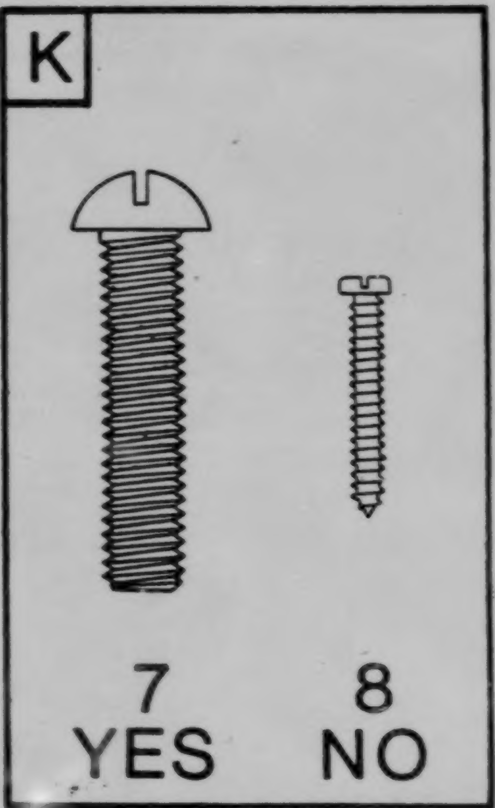
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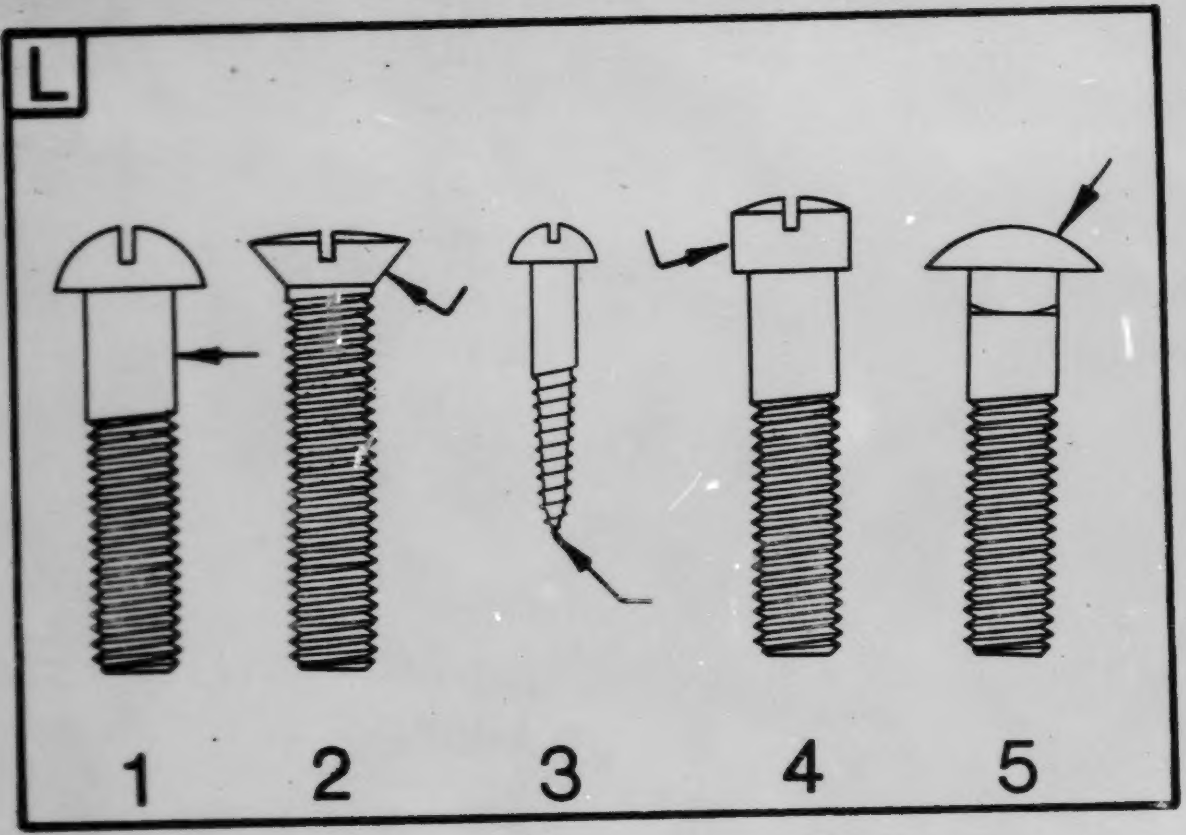
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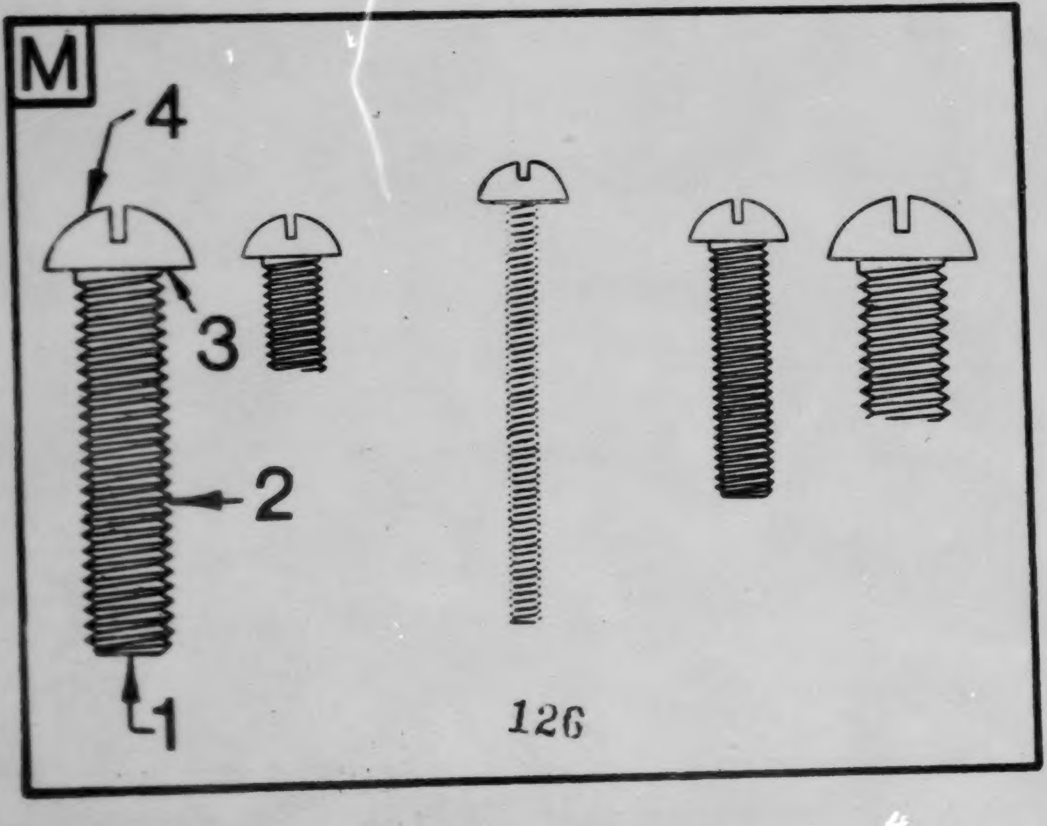
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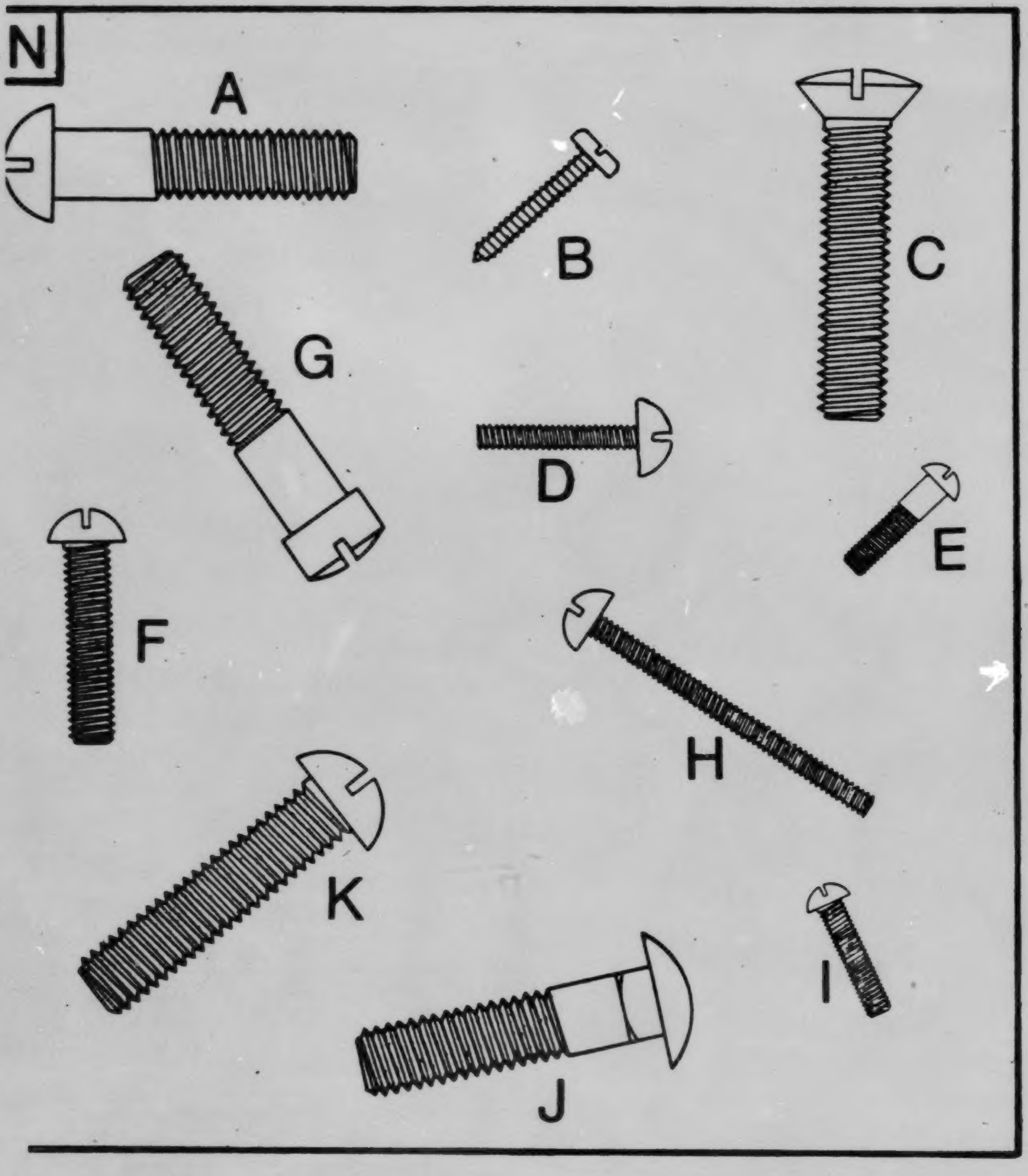
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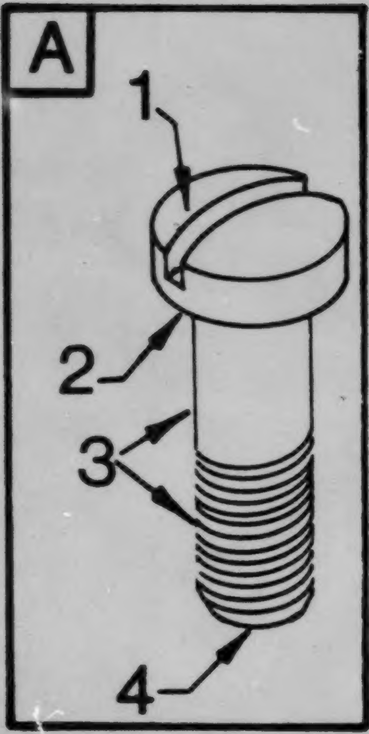
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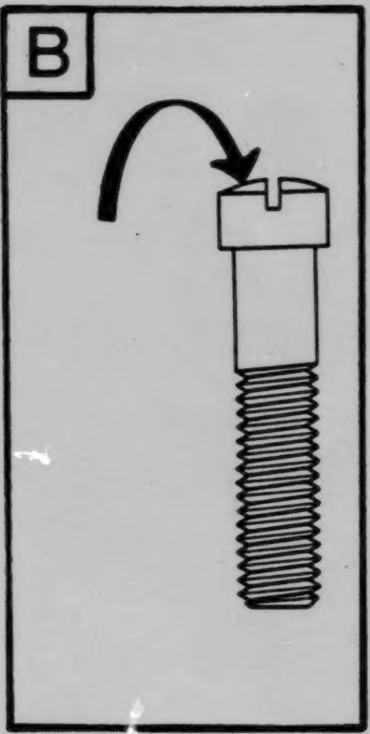
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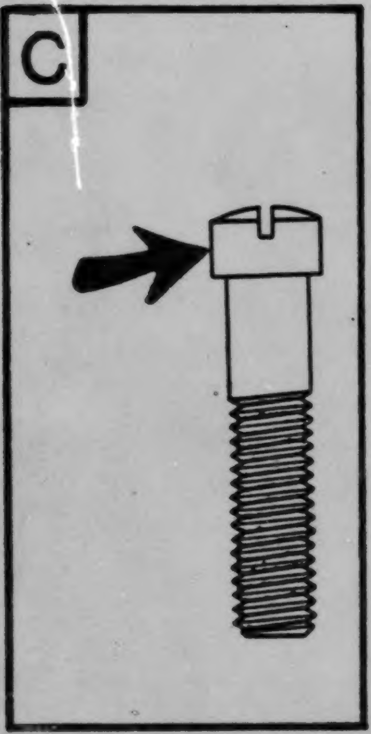
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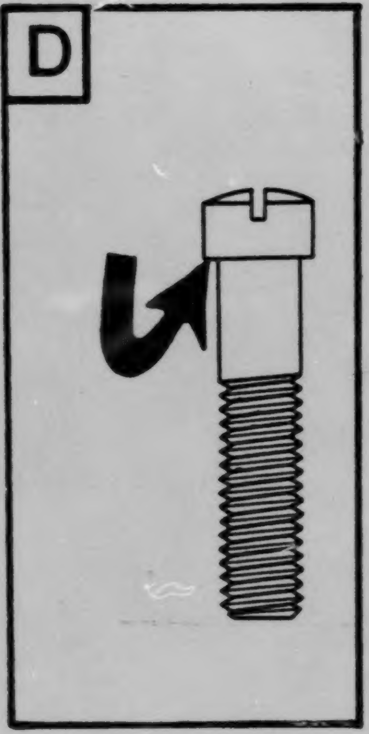
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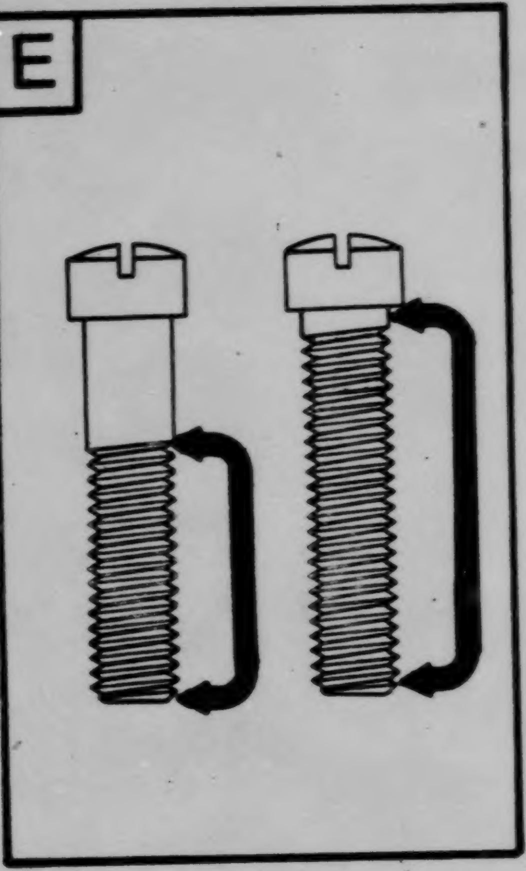
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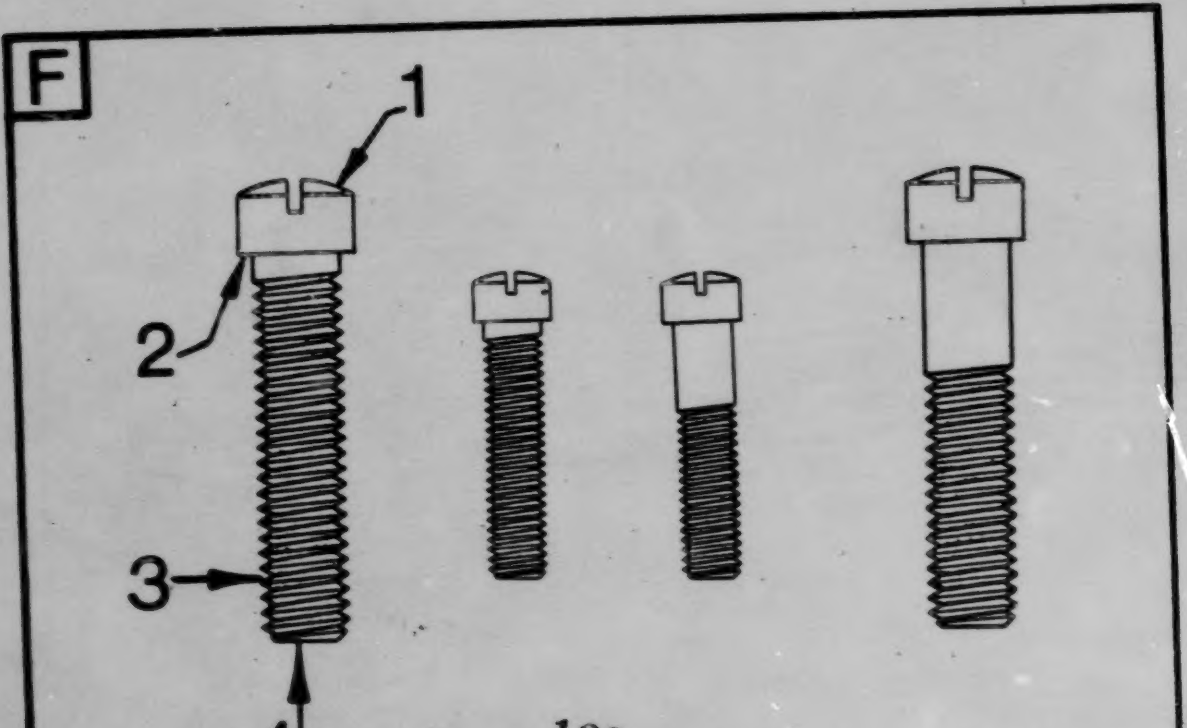
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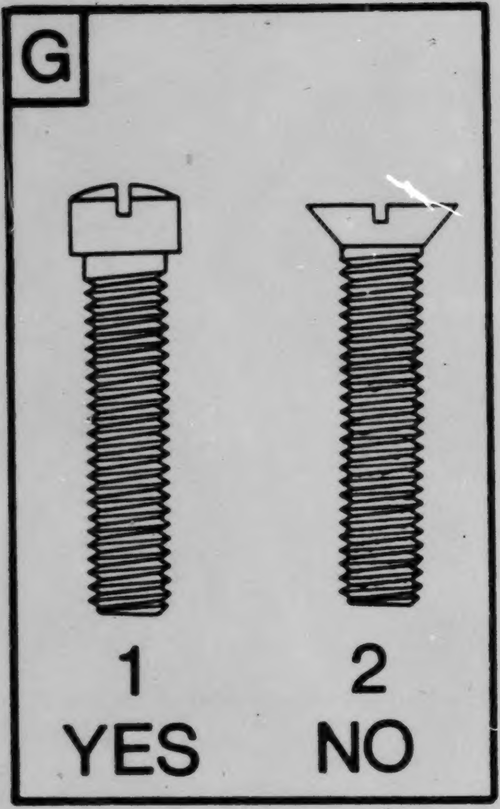
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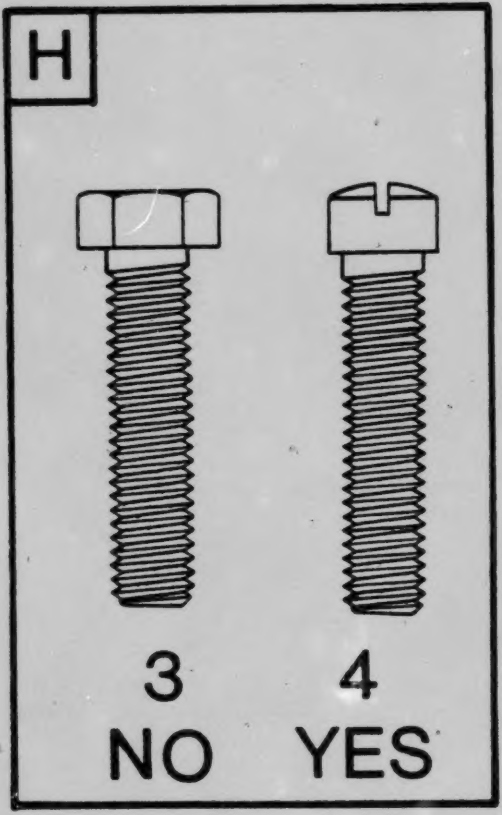
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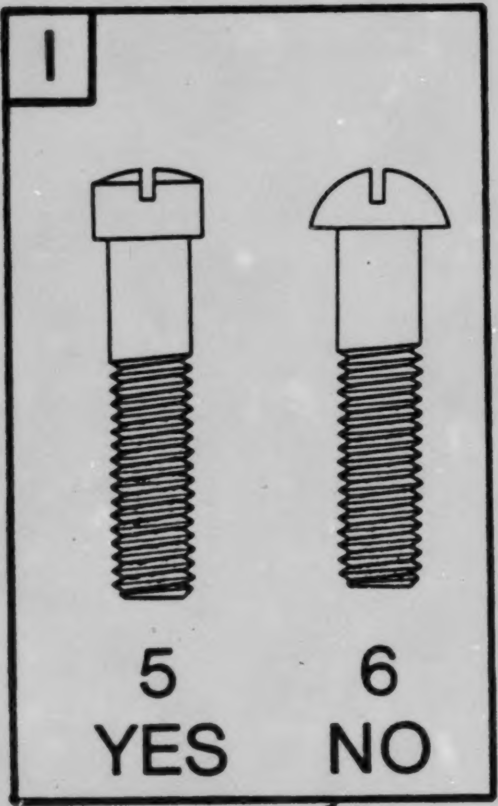
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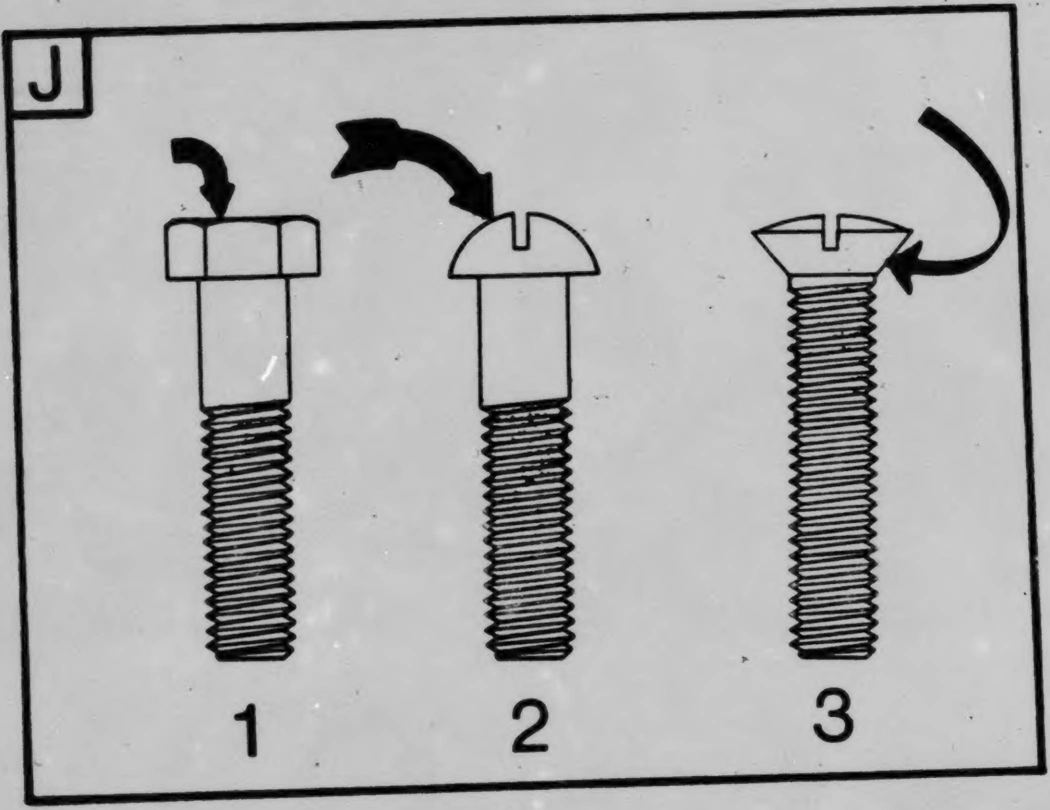
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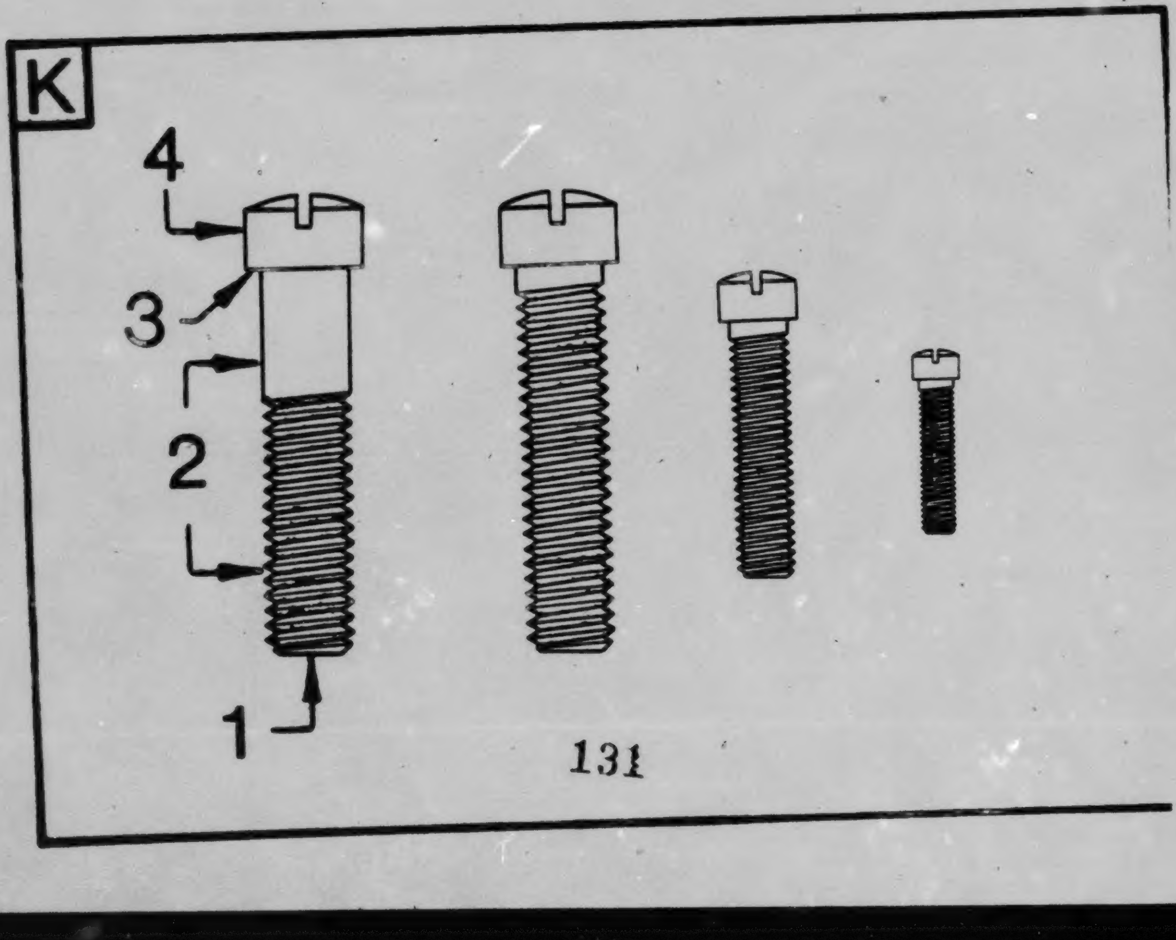
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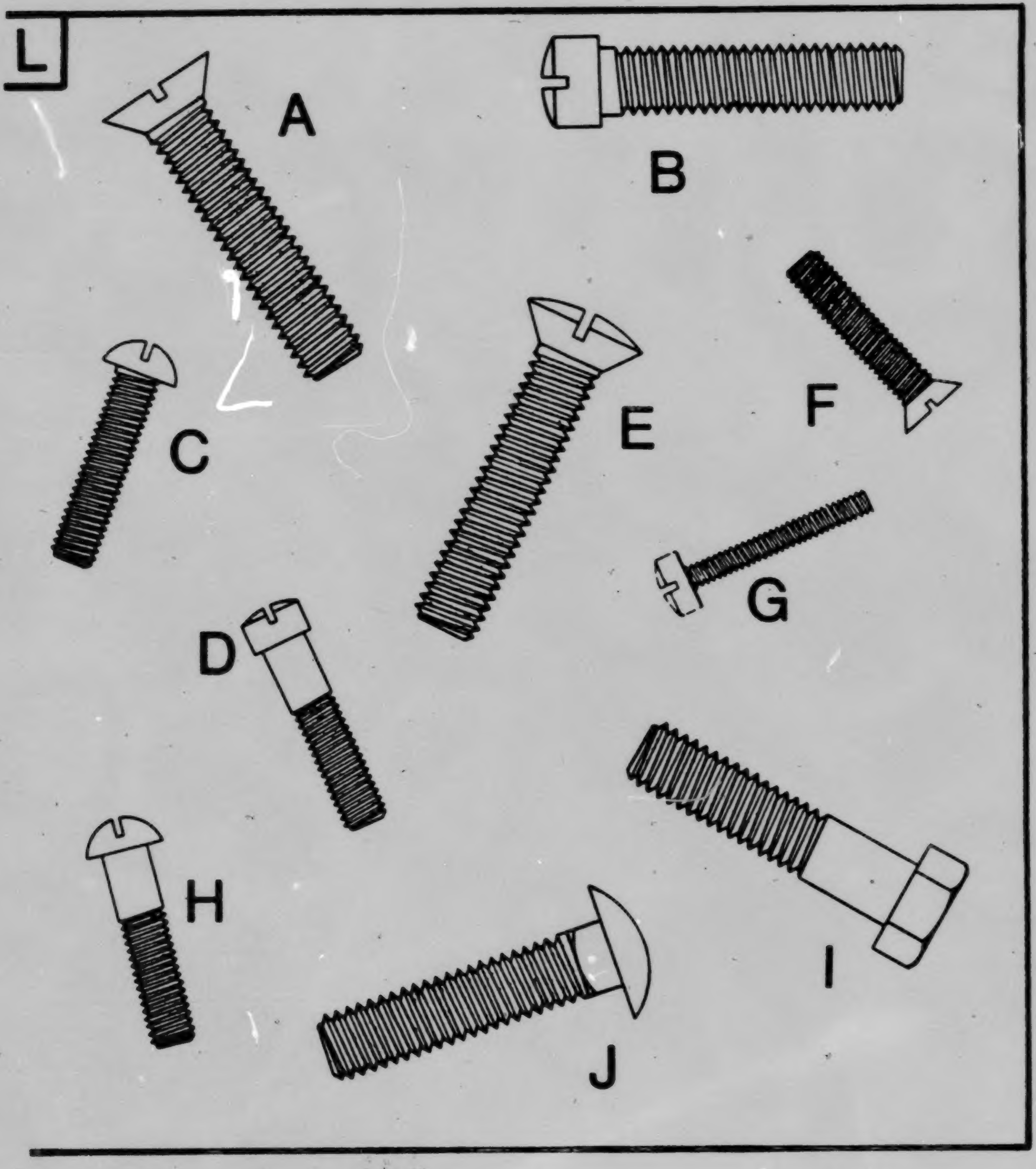
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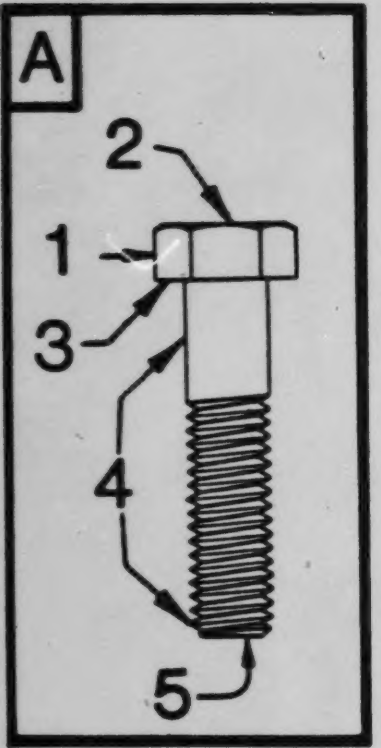
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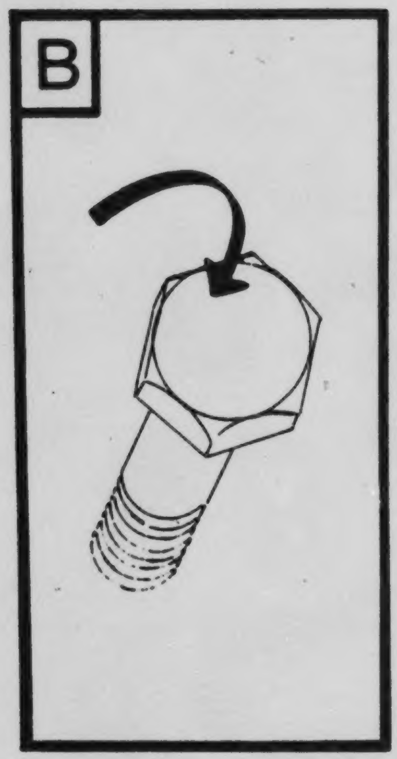
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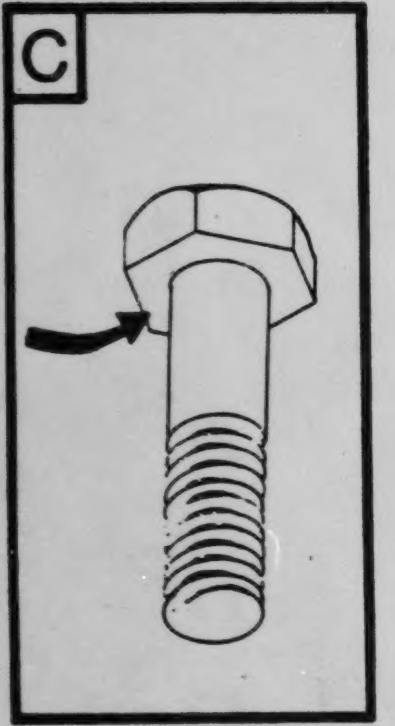
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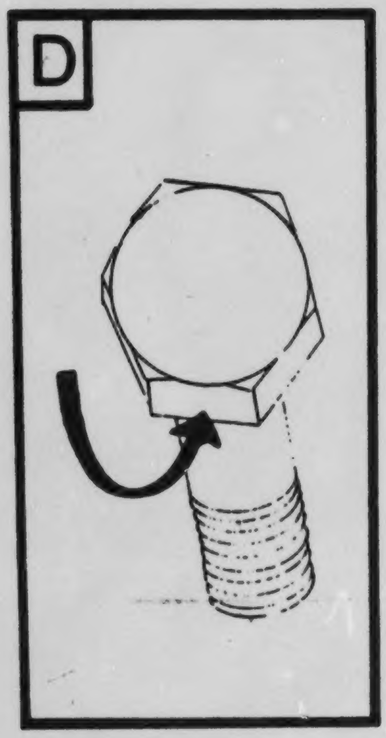
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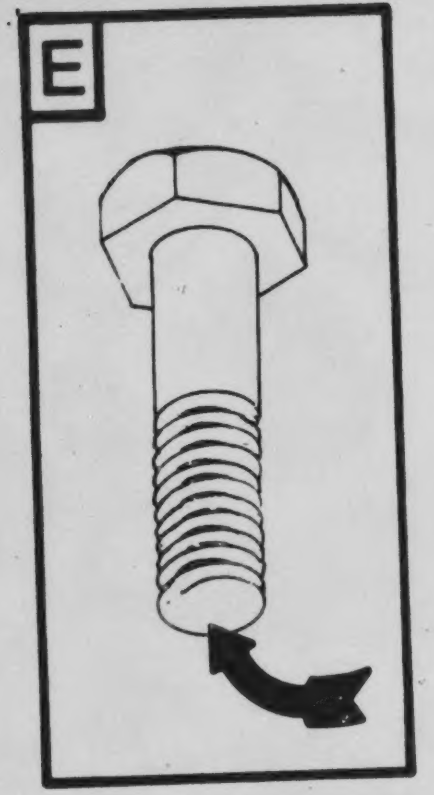
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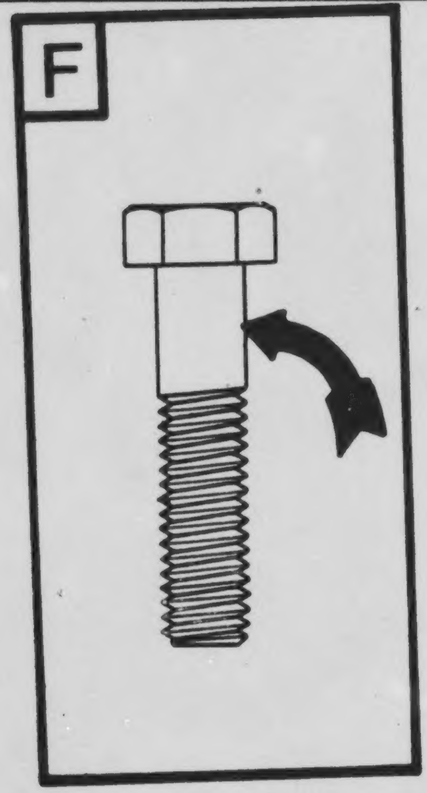
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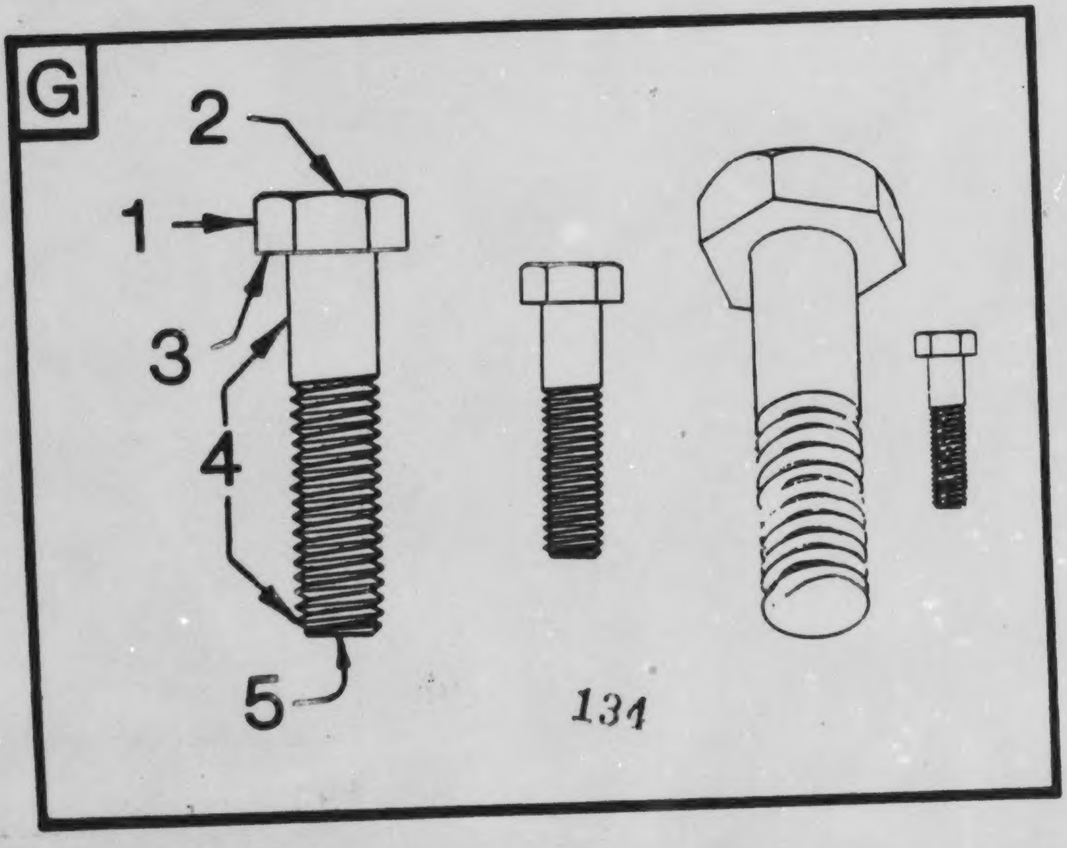
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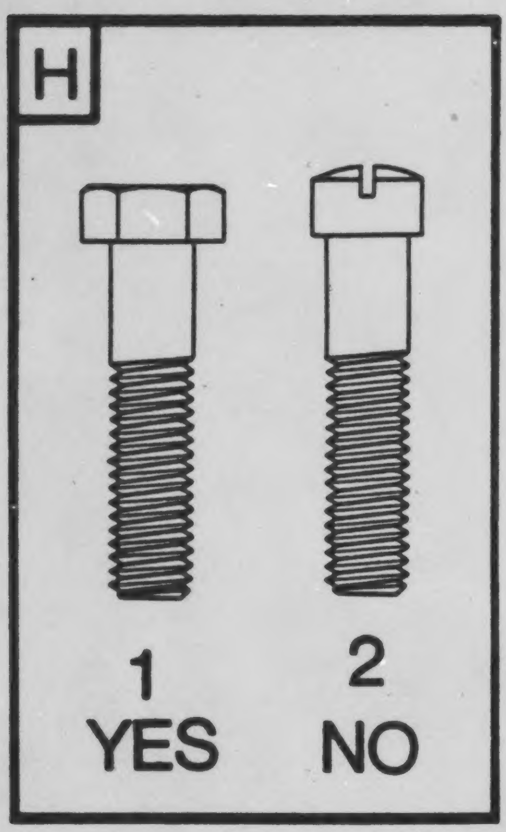
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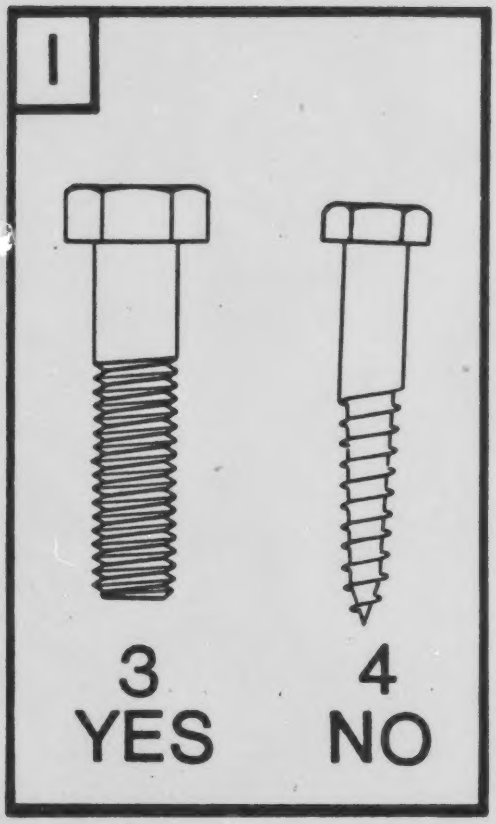
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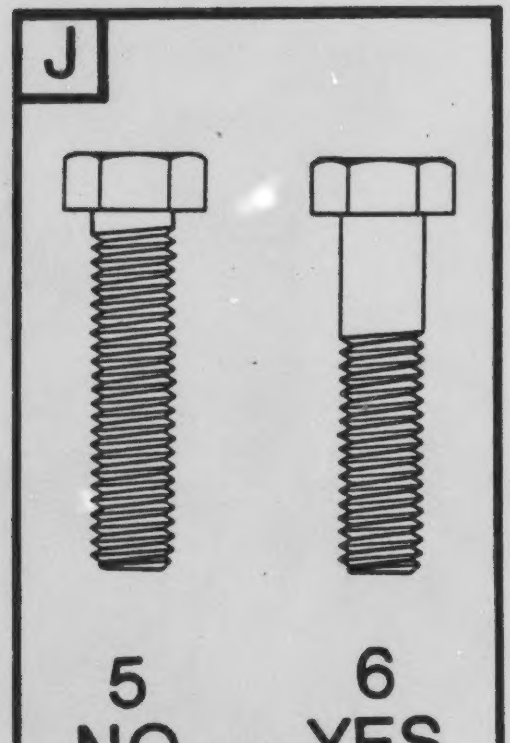
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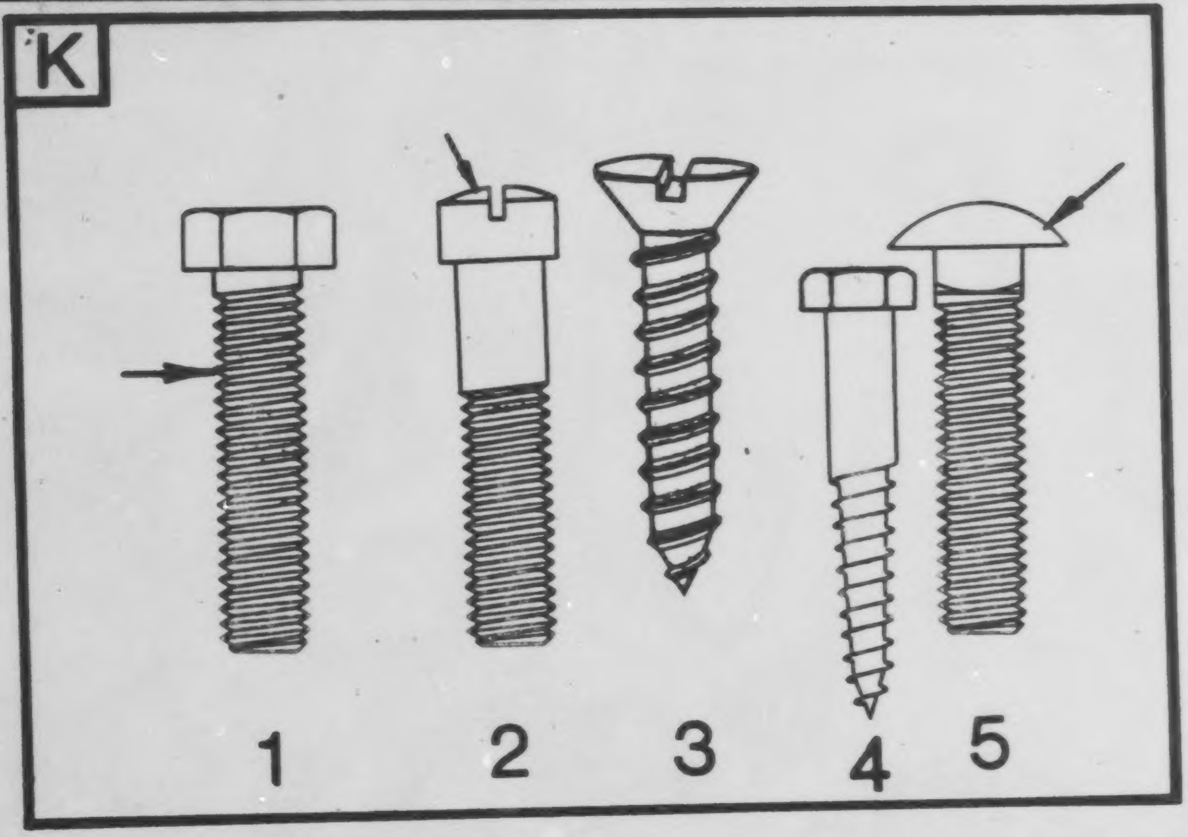
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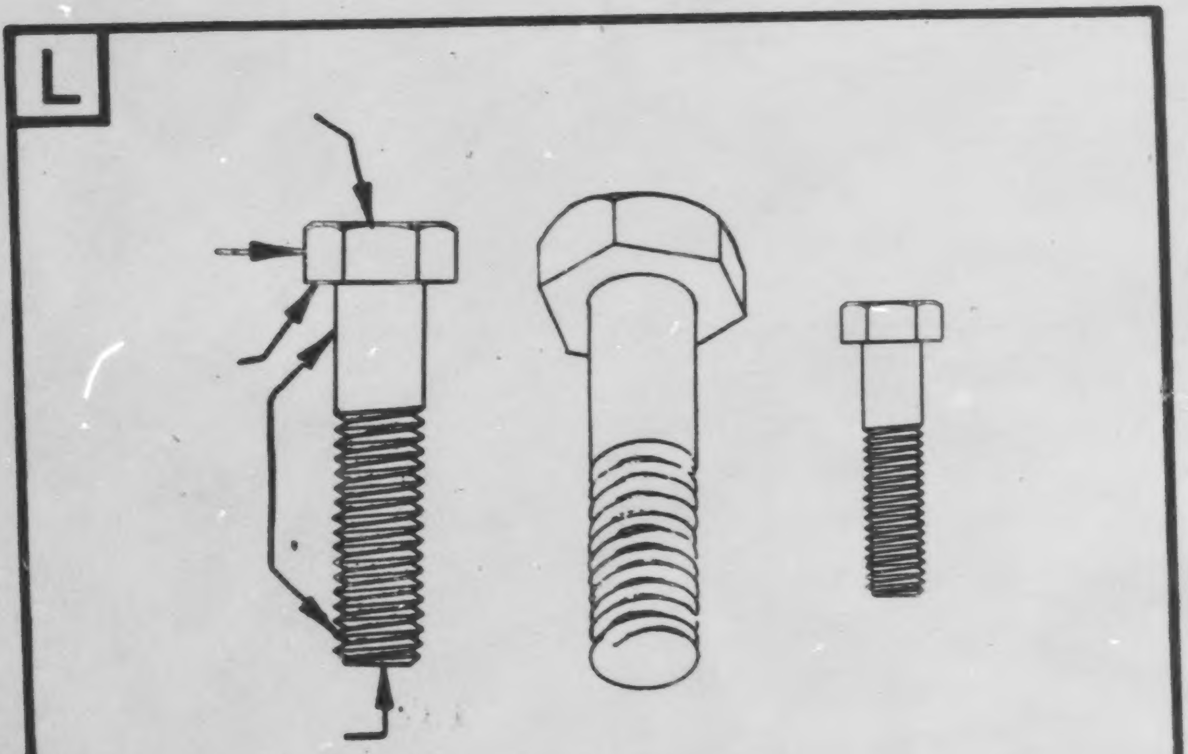
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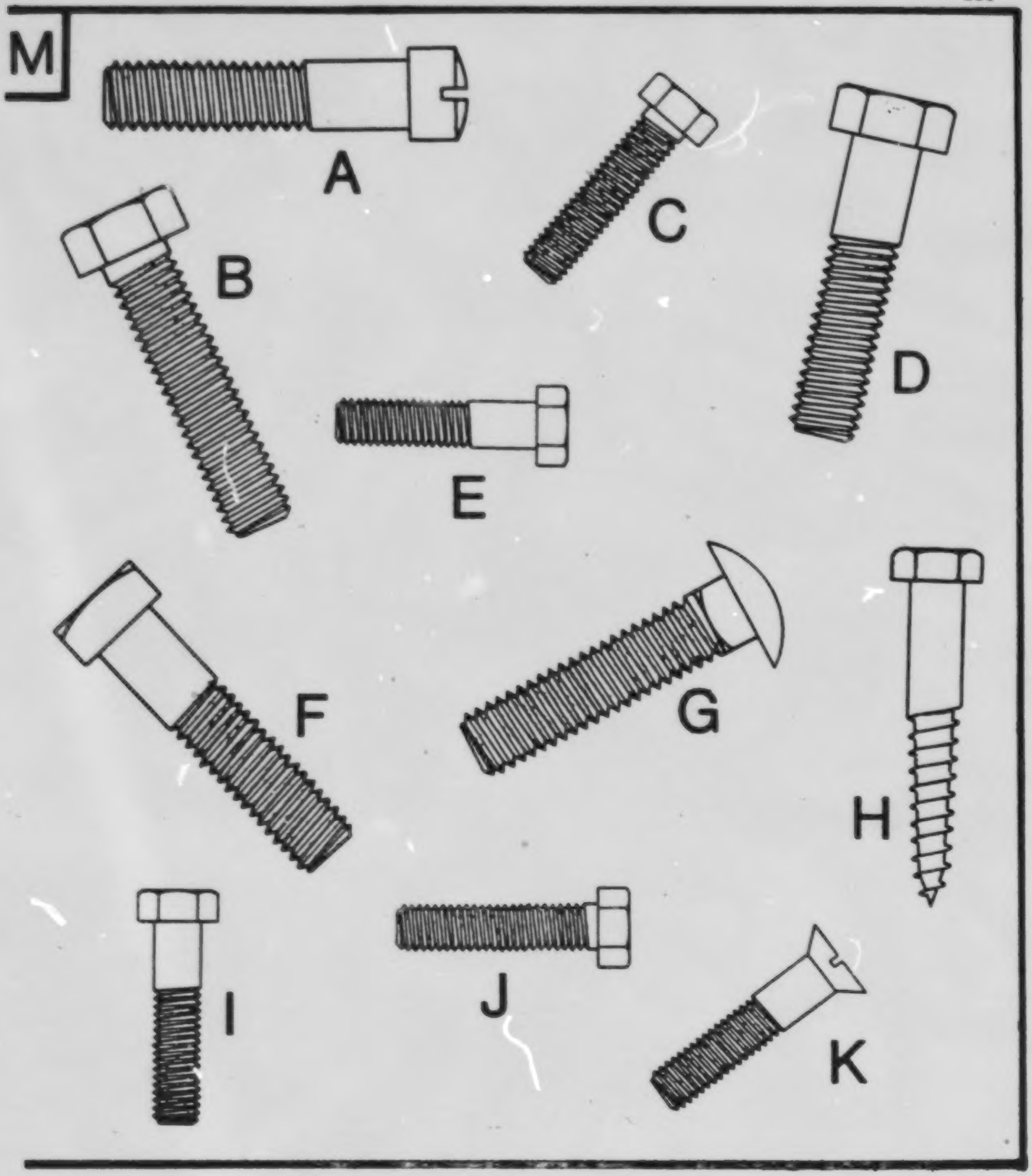
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APPENDIX B

Test Instruments Used in the Study

1. Pretest for screws and bolts (English version)*
2. Posttest for screws and bolts (English version)
3. Pretest for screws and bolts (Spanish version)*
4. Posttest for screws and bolts (Spanish version)*
5. Pretest for plumbing symbols (English version)*
6. Posttest (Form 1*, Form 2) for plumbing symbols (English version)
7. Pretest for plumbing symbols (Spanish version)*
8. Posttest (Form 1, Form 2*) for plumbing symbols (Spanish version)

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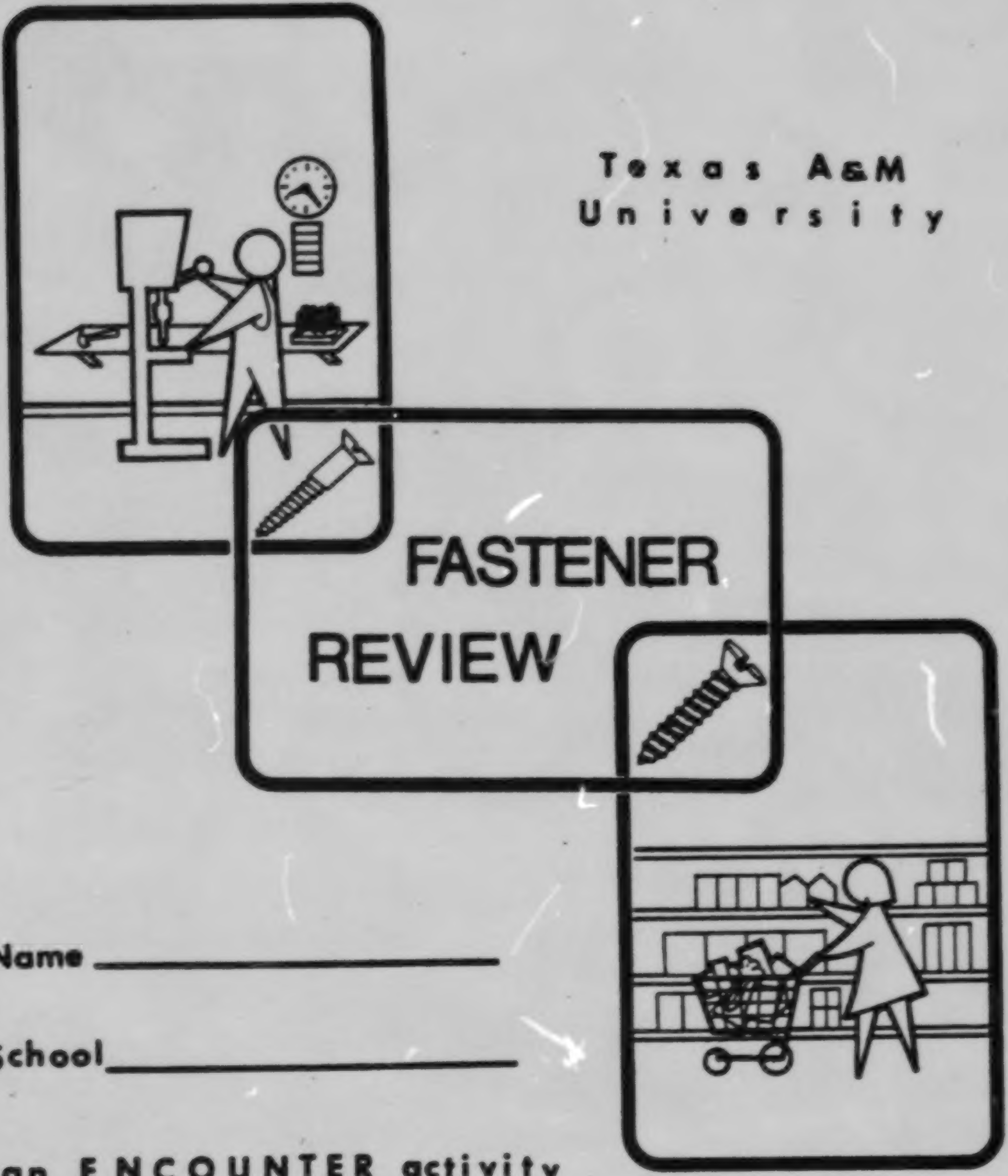
* May be obtained upon request from the Center for Career Development and Occupational Preparation, College of Education, Texas A & M University, College Station, Texas 77843.

Texas A&M
University



FASTENER REVIEW

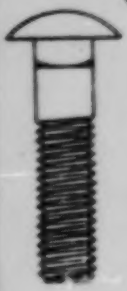
Name ____________________

School____________________

an ENCOUNTER activity
College of Education

form2

1 **SELECT THE FILLISTER HEAD CAP SCREW.**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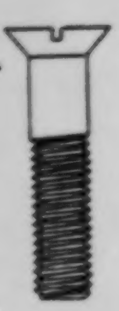
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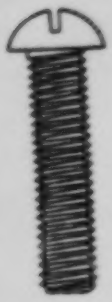
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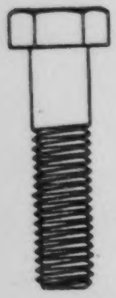
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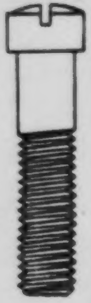
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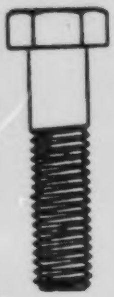
2 **SELECT THE HEXAGON HEAD BOLT.**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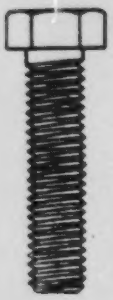
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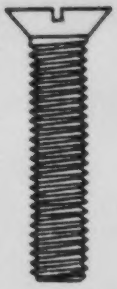
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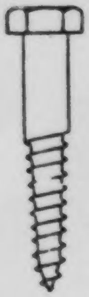
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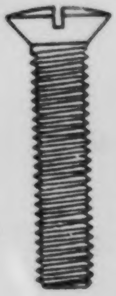
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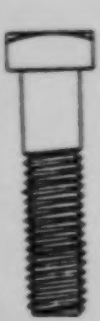
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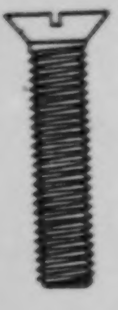
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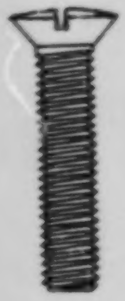
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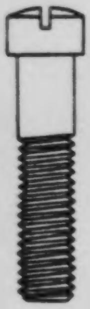
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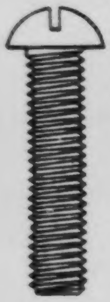
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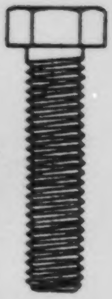
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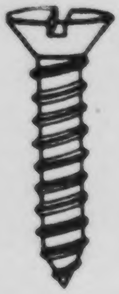
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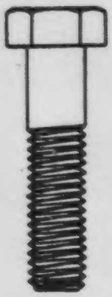
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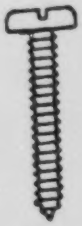
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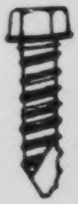
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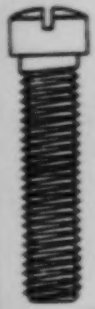
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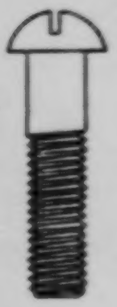
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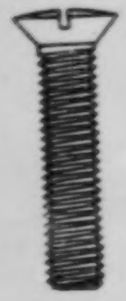
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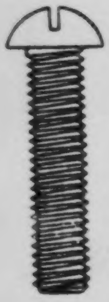
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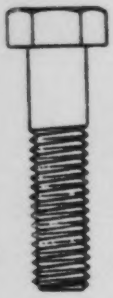
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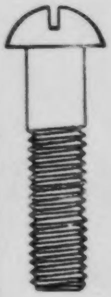
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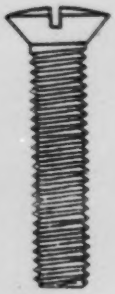
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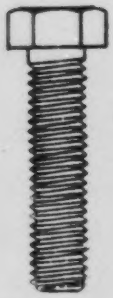
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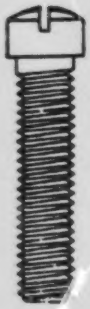
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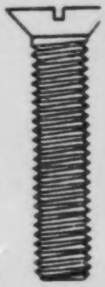
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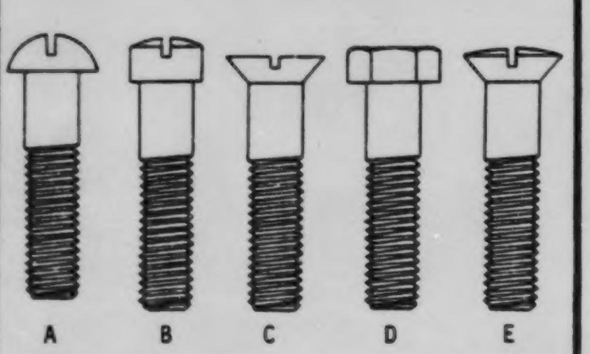

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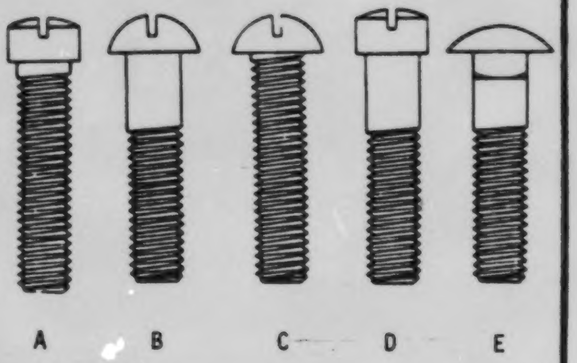

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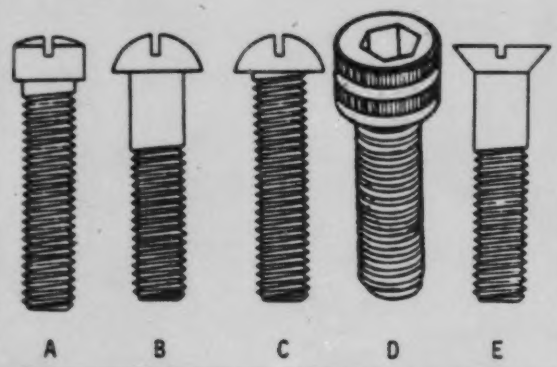

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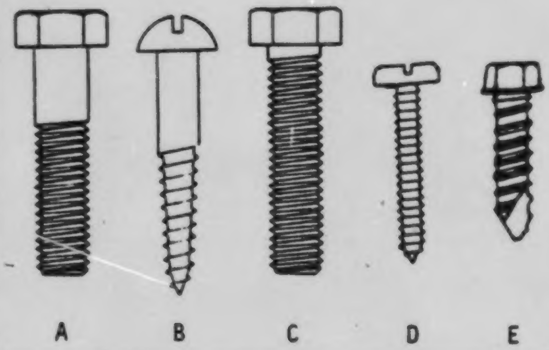
SELECT THE HEXAGON HEAD BOLT.



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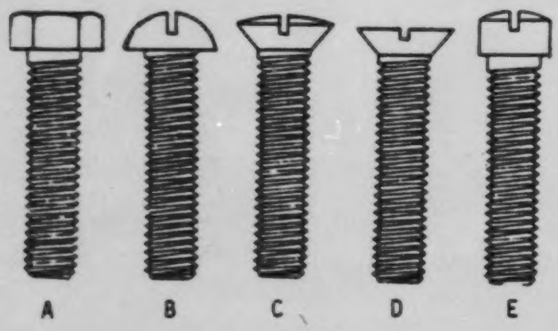

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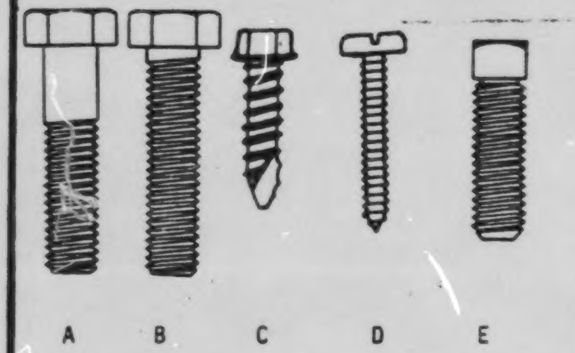

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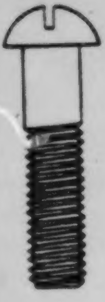
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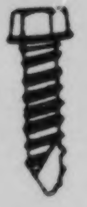
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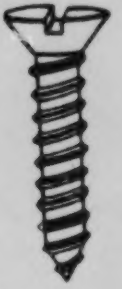
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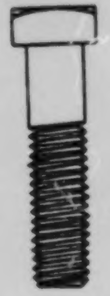
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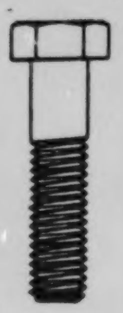
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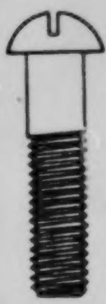
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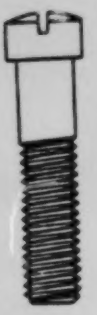
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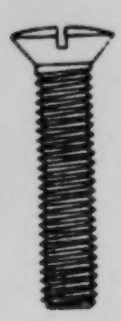
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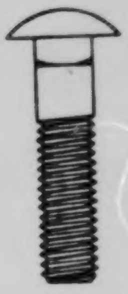
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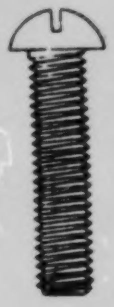
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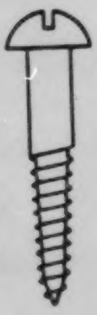
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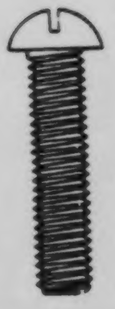
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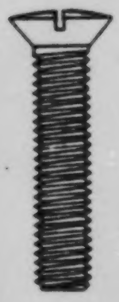
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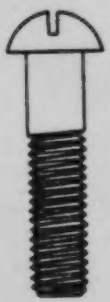
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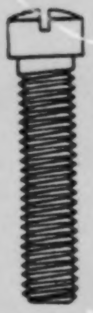
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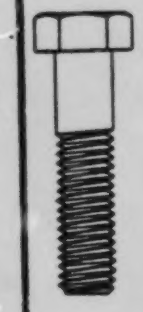
16 **SELECT THE HEXAGON HEAD BOLT.**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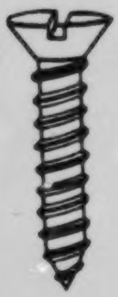
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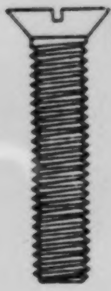
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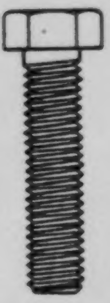
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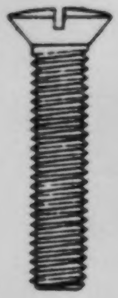
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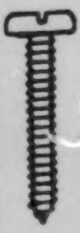
17 **SELECT THE FILLISTER HEAD CAP SCREW.**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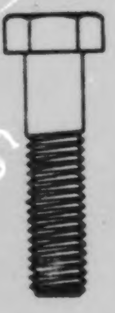
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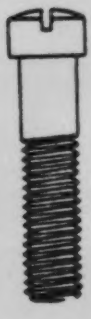
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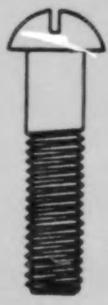
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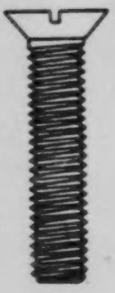
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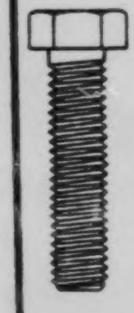
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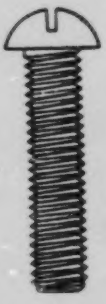
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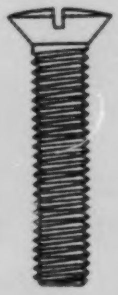
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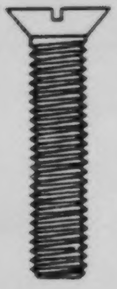
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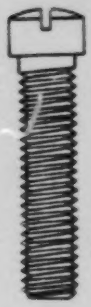
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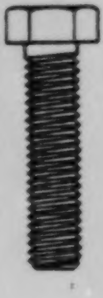
19 SELECT THE HEXAGON HEAD BOLT.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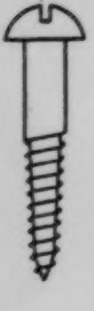
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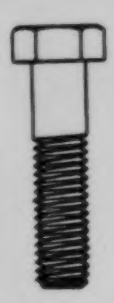
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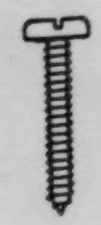
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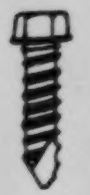
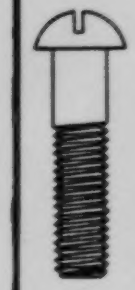

E

20 SELECT THE FILLISTER HEAD CAP SCREW.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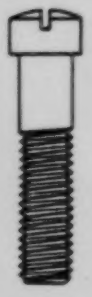
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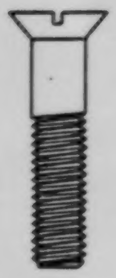
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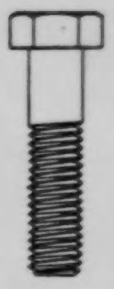
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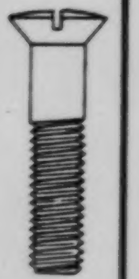
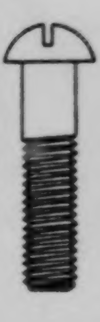

E

21 SELECT THE FILLISTER HEAD CAP SCREW.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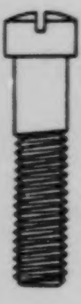
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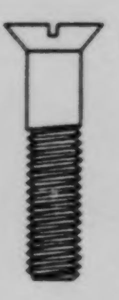
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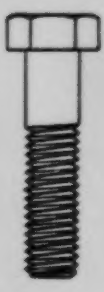
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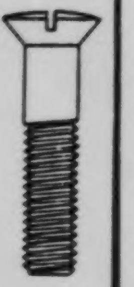
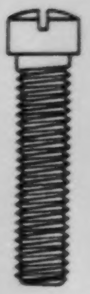

E

22 SELECT THE ROUND HEAD MACHINE SCREW.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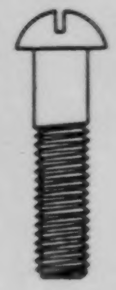
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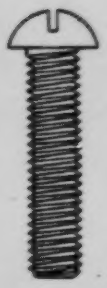
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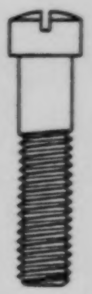
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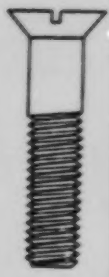
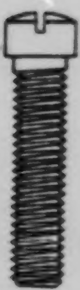

E

23 SELECT THE ROUND HEAD MACHINE SCREW.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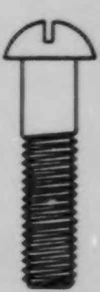
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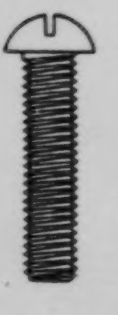
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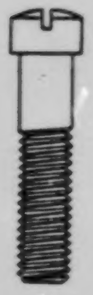
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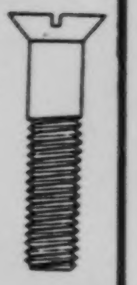
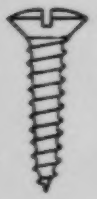

E

24 SELECT THE HEXAGON HEAD BOLT.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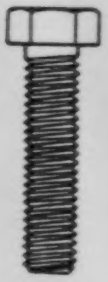
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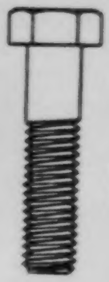
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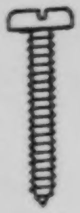
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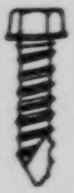
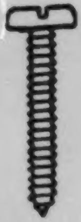

E

25 SELECT THE HEXAGON HEAD BOLT.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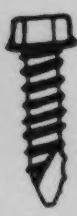
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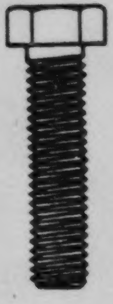
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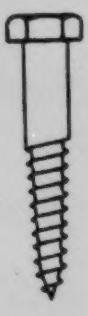
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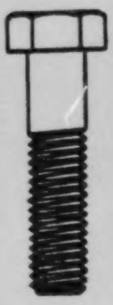
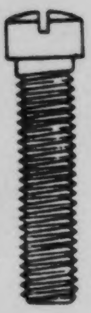

E

26 SELECT THE FILLISTER HEAD CAP SCRE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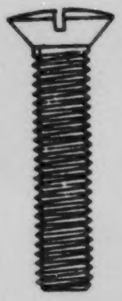
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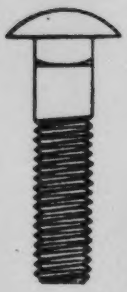
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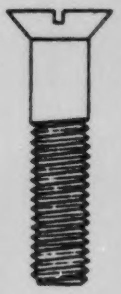
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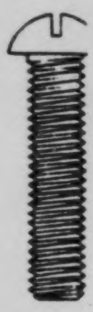
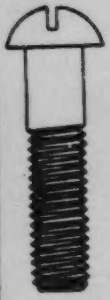

E

27 SELECT THE FILLISTER HEAD CAP SCREW.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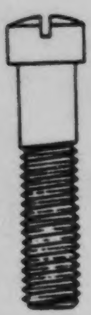
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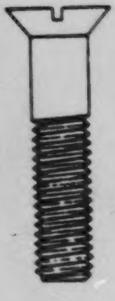
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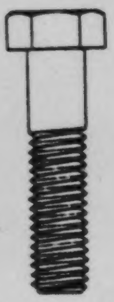
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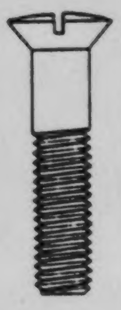
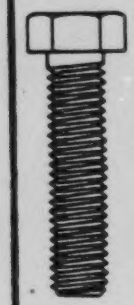

E

28 SELECT THE HEXAGON HEAD BOLT.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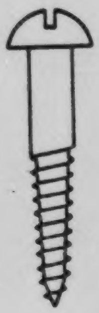
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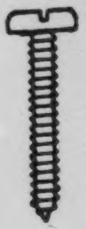
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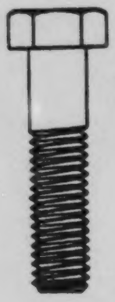
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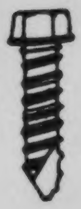
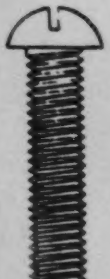

E

29 SELECT THE ROUND HEAD MACHINE SCREW.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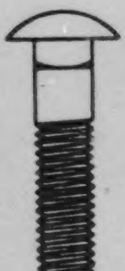
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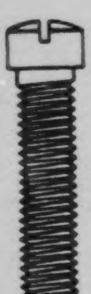
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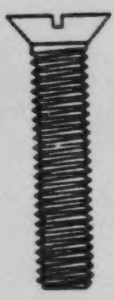
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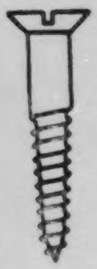
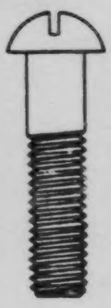

E

30 SELECT THE ROUND HEAD MACHINE SCREW.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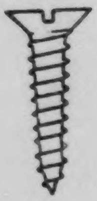
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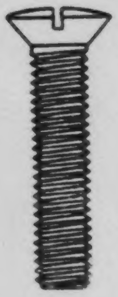
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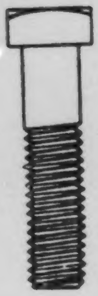
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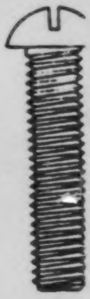
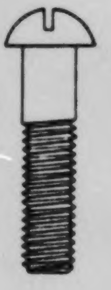

E

31 SELECT THE FILLISTER HEAD CAP SCREW.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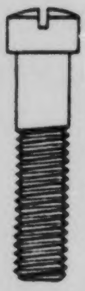
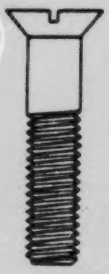

B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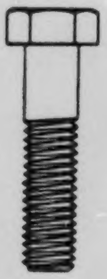
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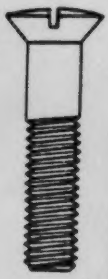
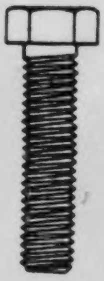

E

32 SELECT THE HEXAGON HEAD BOLT.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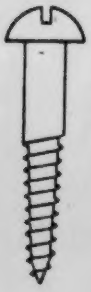
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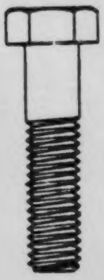
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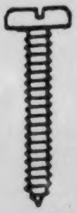
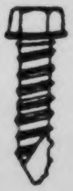
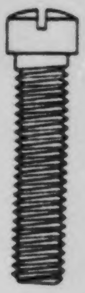

D


E

33 SELECT THE ROUND HEAD MACHINE SCREW.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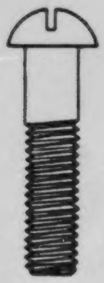
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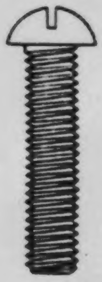
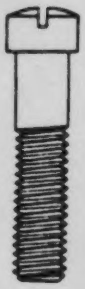

C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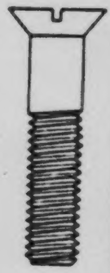
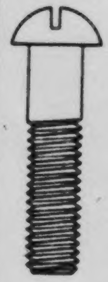

E

34 SELECT THE FILLISTER HEAD CAP SCREW.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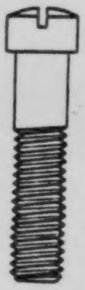
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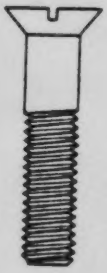
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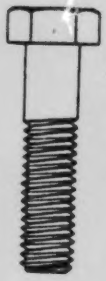
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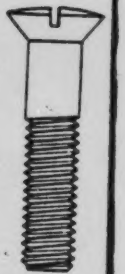
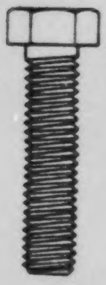

E

35 SELECT THE HEXAGON HEAD BOLT.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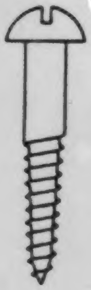
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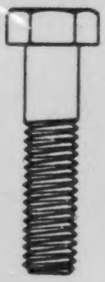
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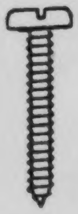
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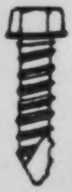
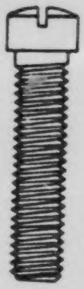

E

36 SELECT THE ROUND HEAD MACHINE SCREW.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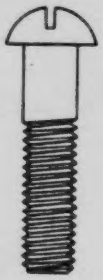
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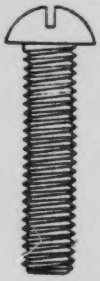
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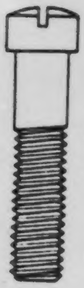
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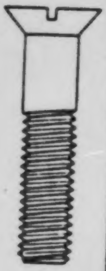
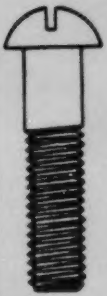

E

37 **SELECT THE FILLISTER HEAD CAP SCREW.**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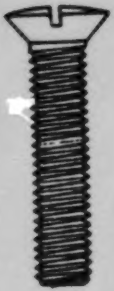
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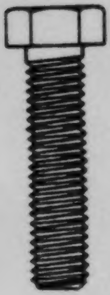
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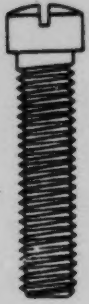
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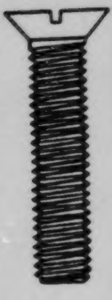
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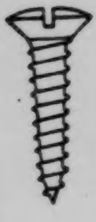
38 **SELECT THE HEXAGON HEAD BOLT.**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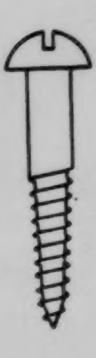
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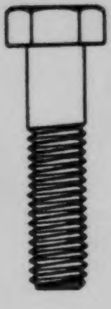
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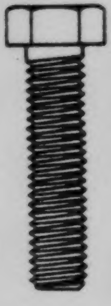
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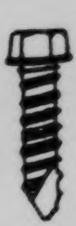
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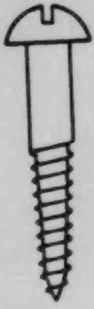
39 **SELECT THE HEXAGON HEAD BOLT.**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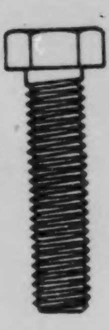
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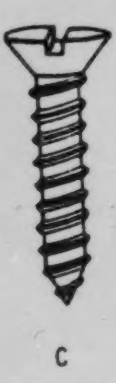
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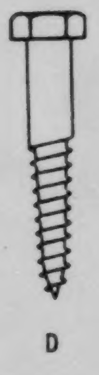
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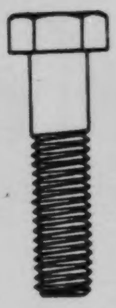
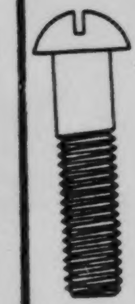

E

40 **SELECT THE ROUND HEAD MACHINE SCREW.**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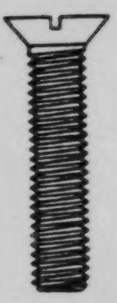
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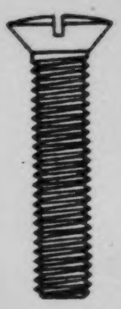
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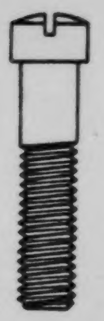
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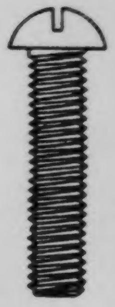
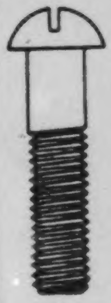

E

41 **SELECT THE FILLISTER HEAD CAP SCREW.**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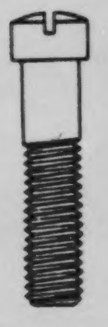
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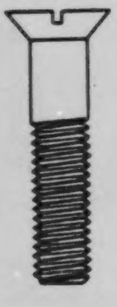
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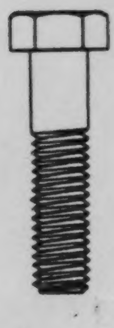
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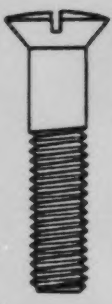
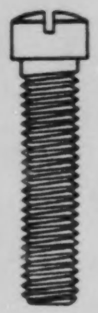

E

42 **SELECT THE ROUND HEAD MACHINE SCREW.**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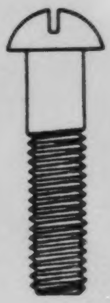
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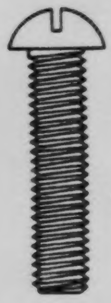
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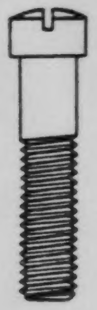
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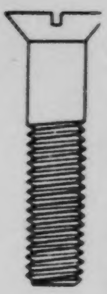
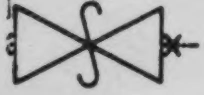

E

PLUMBING SYMBOL POSTTEST

Multiple Component Questions

English

Select the globe valve connected to pipes by soldered joints.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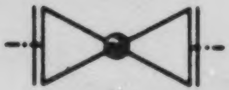
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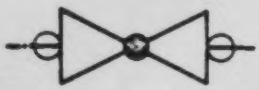
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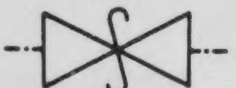
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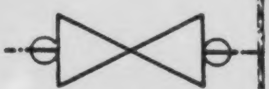
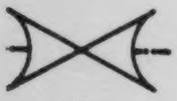

e

Select the gate valve that is connected to cold water pipes by welded joints.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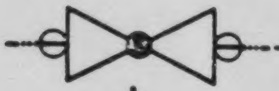
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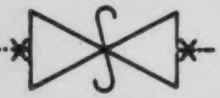
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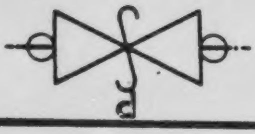
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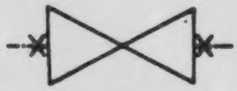
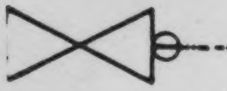

e

Select the gate valve that is connected to hot water pipes by soldered joints.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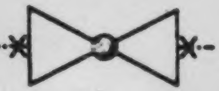
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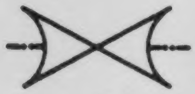
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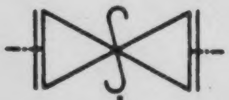
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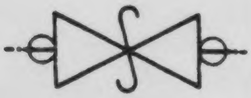
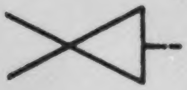

e

elect the globe valve connected to cold water pipes by soldered joints.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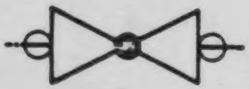
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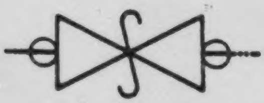
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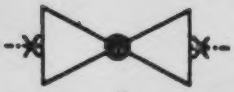
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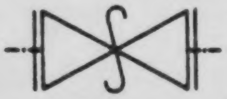
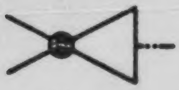

e

lect the globe valve connected to hot water pipes.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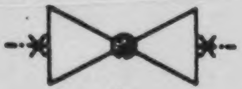
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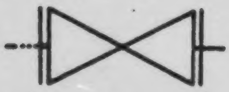
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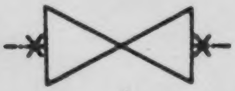
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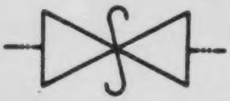
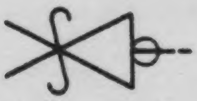

e

lect the valve that is connected to hot water pipes by soldered joints.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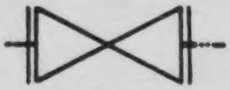
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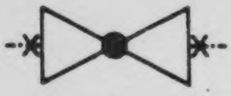
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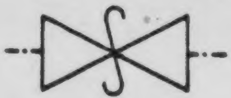
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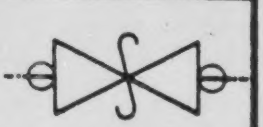
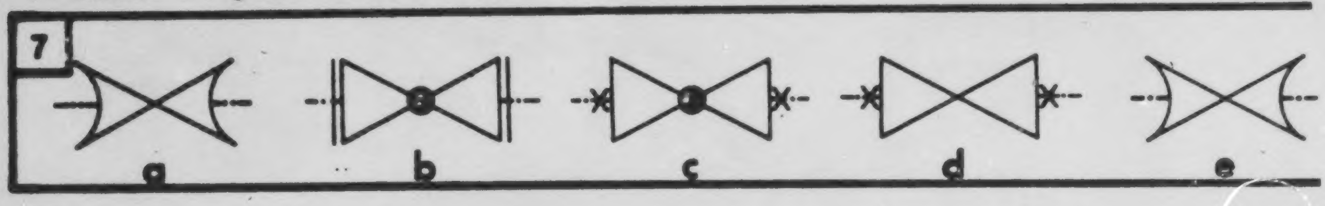
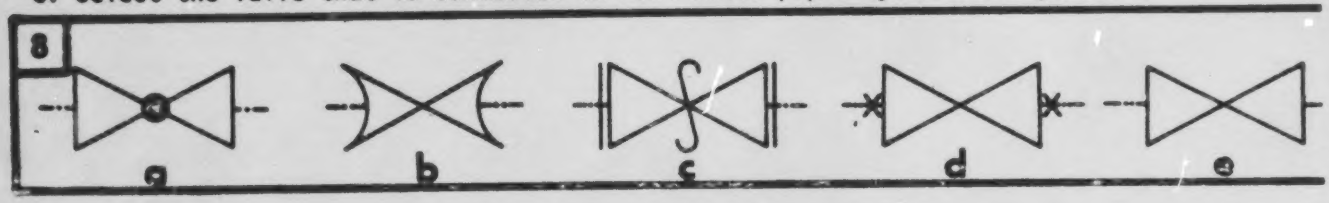

e

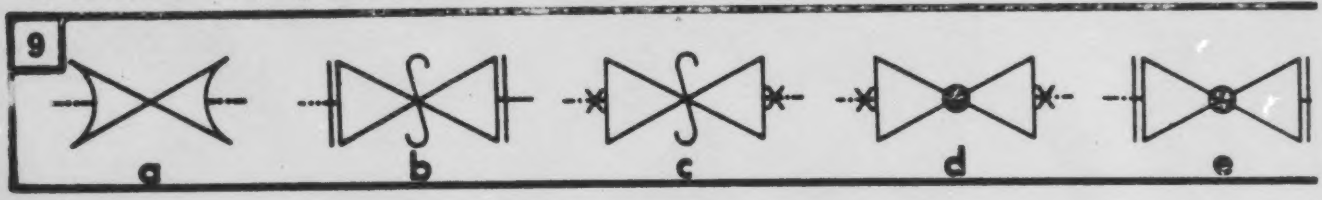
7. Select the globe valve with welded joints.



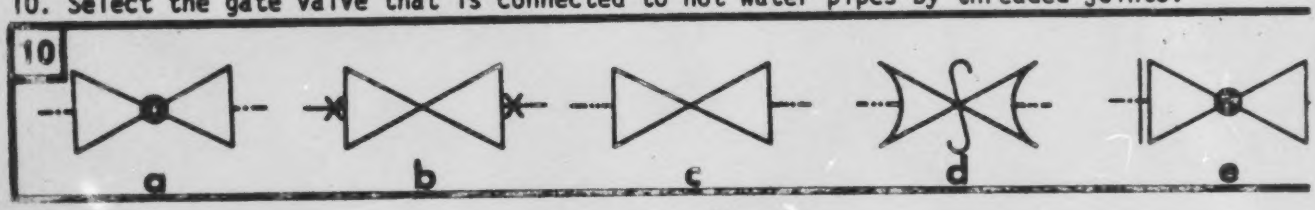
8. Select the valve that is connected to cold water pipes by threaded joints.



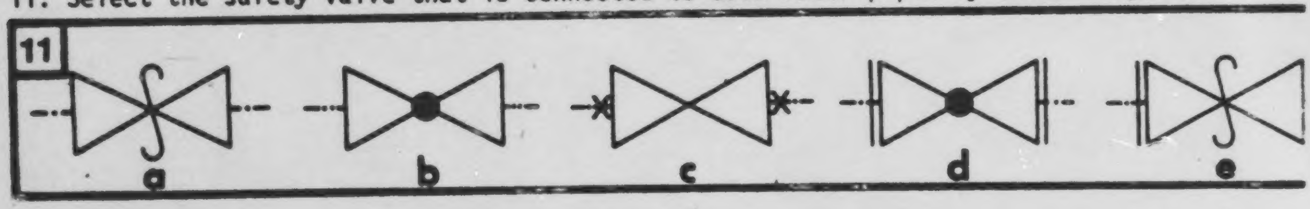
9. Select the safety valve that is connected to cold water pipes by welded joints.



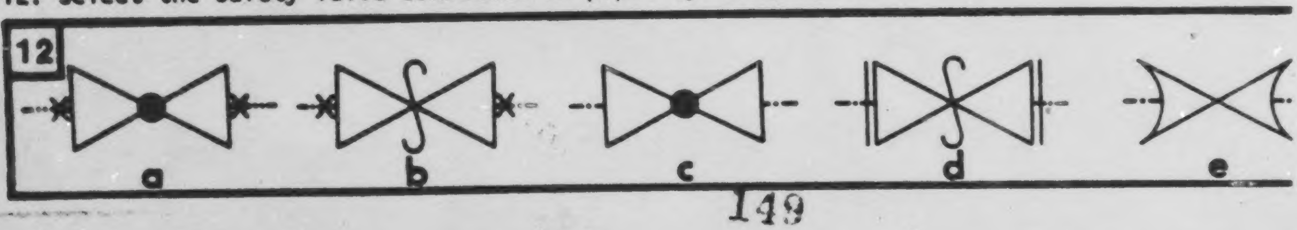
10. Select the gate valve that is connected to hot water pipes by threaded joints.



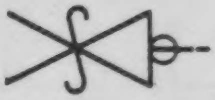
11. Select the safety valve that is connected to cold water pipes by threaded joints.



12. Select the safety valve connected to pipes by welded joints.



Select the safety valve that is connected to cold water pipes.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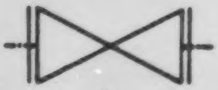
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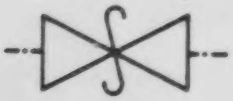
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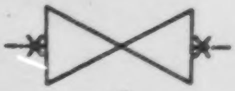
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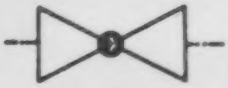
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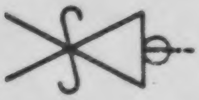
Select the safety valve that is connected to hot water pipes by welded joints.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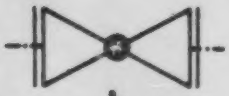
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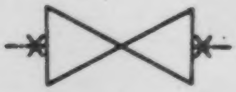
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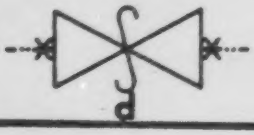
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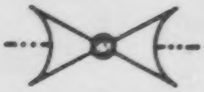
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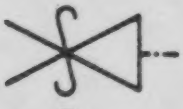
elect the globe valve that is connected to pipes by threaded joints.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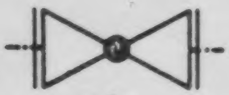
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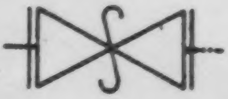
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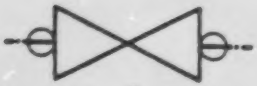
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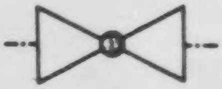
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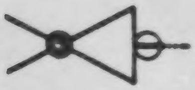
elect the globe valve that is connected to cold water pipes by welded joints.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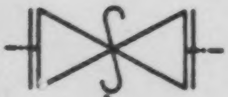
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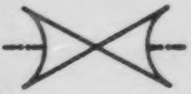
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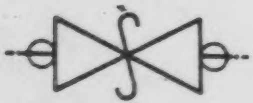
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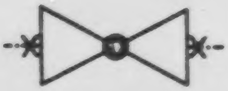
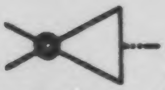

e

lect the globe valve that is connected to hot water pipes by threaded joints.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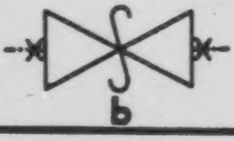
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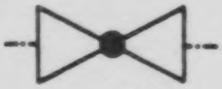
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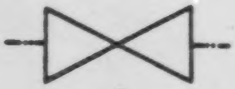
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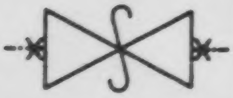
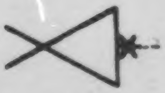

e

lect the valve that is connected to cold water pipes by welded joints.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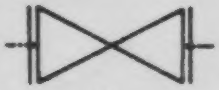
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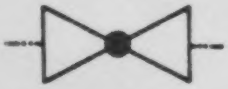
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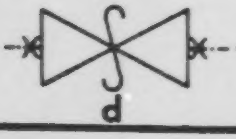
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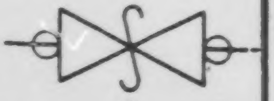
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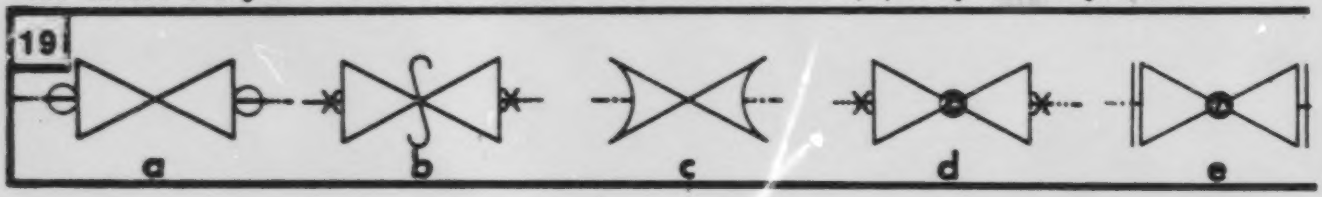
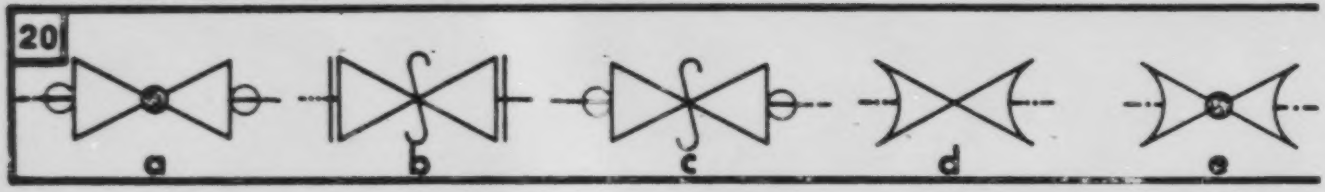
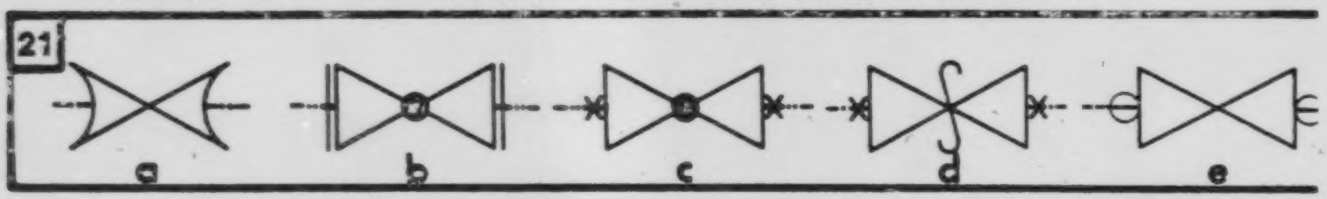
19. Select the globe valve that is connected to hot water pipes by welded joints.



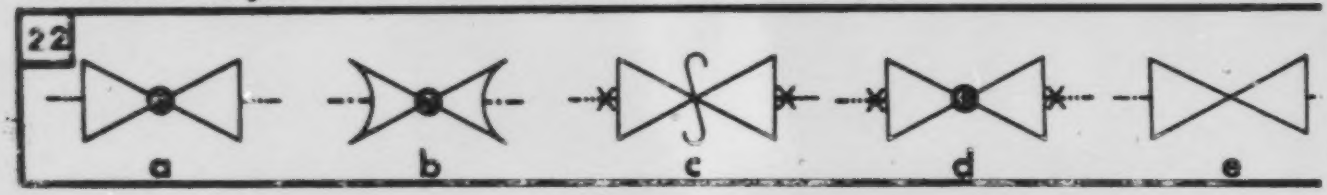
20. Select the safety valve with soldered joints.



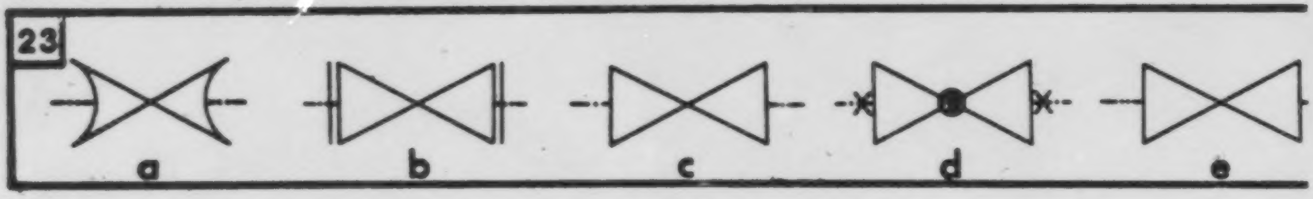
21. Select the valve that is connected to hot water pipes by welded joints.



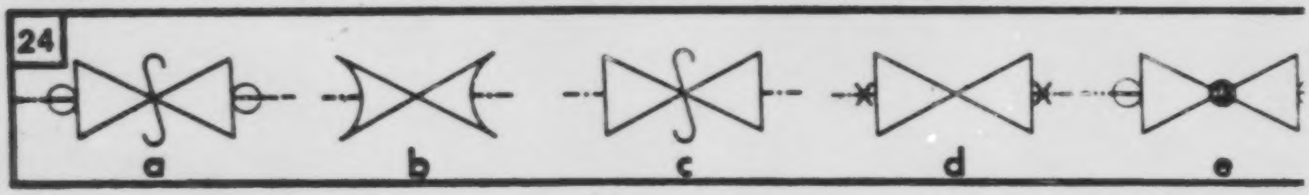
22. Select the gate valve that is connected to cold water pipes.



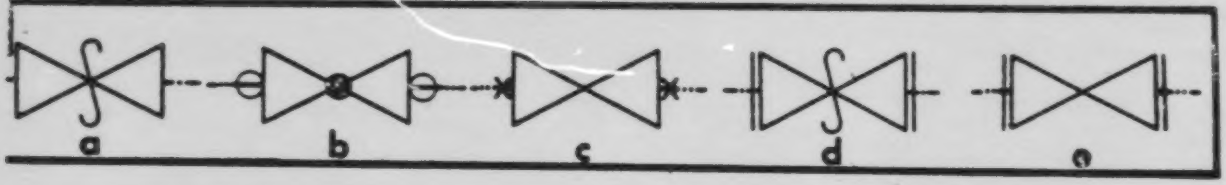
23. Select the gate valve connected to cold water pipes by a threaded joints.



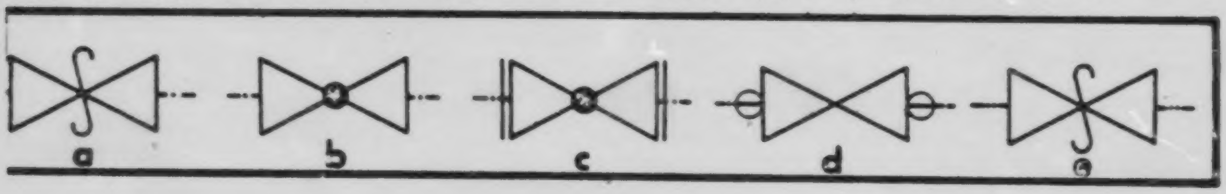
24. Select the safety valve that is connected to hot water pipes by soldered joints.



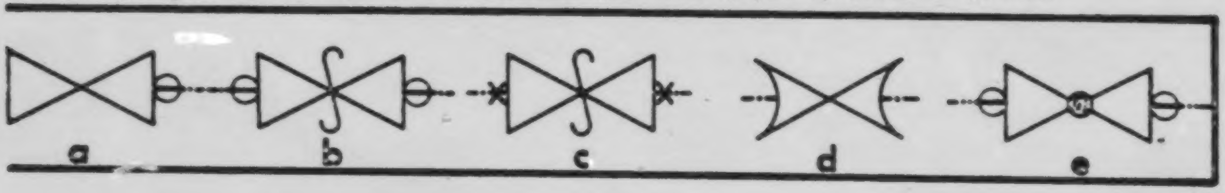
Select the gate valve that is connected to hot water pipes by welded joints.-



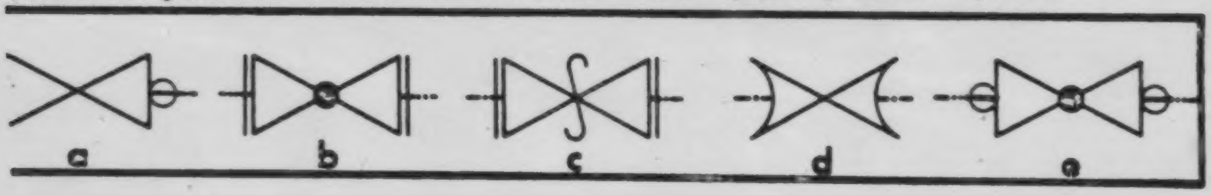
Select the globe valve that is connected to cold water pipes by threaded joints.



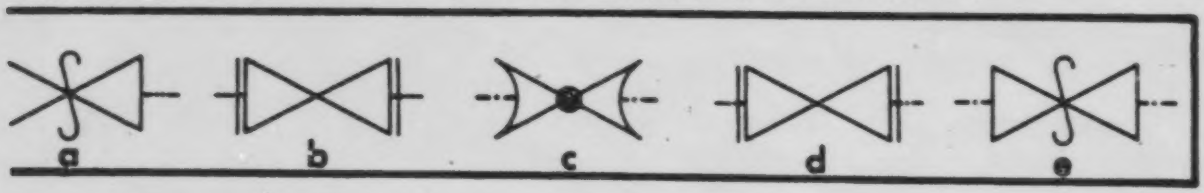
Select the gate valve that is connected to the water pipes by soldered joints.



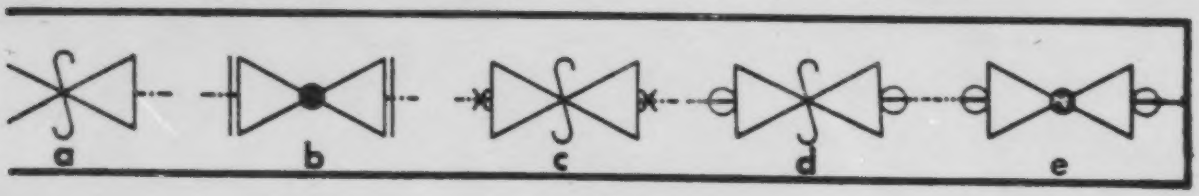
Select the globe valve that is connected to hot water pipes by soldered joints.



Select the valve that is connected to hot water pipes by threaded joints.

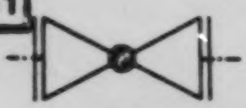


Select the safety valve that is connected to water pipes by threaded joints.



31. Select the gate valve with threaded joints.

31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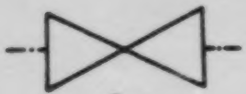
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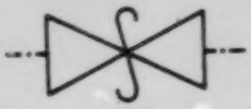
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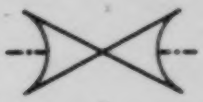
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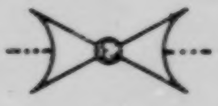
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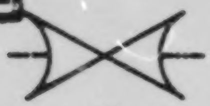
32. Select the valve that is connected to cold water pipes by soldered joints.

32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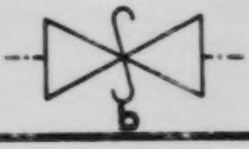
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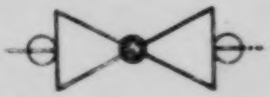
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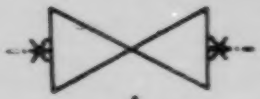
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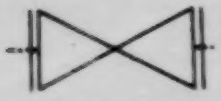
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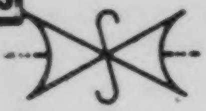
33. Select the safety valve that is connected to hot water pipes.

33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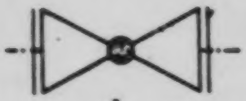
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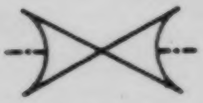
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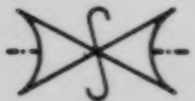
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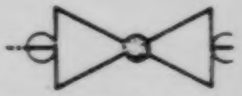
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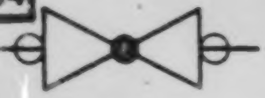
34. Select the safety valve that is connected to cold water pipes by soldered joints.

34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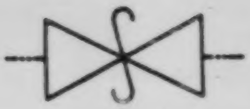
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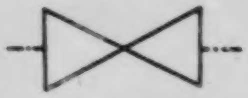
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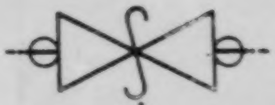
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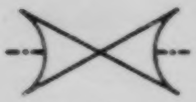
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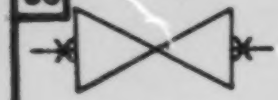
35. Select the globe valve that is connected to cold water pipes.

35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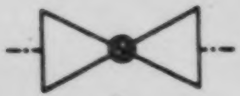
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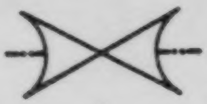
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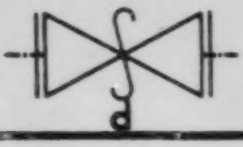
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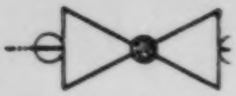
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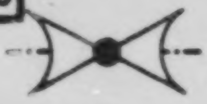
36. Select the safety valve that is connected to hot water pipes by threaded joints.

36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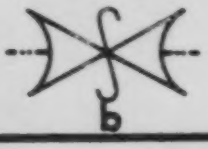
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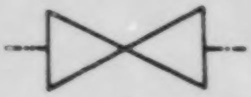
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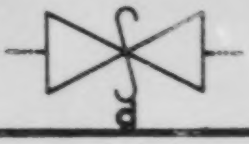
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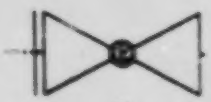
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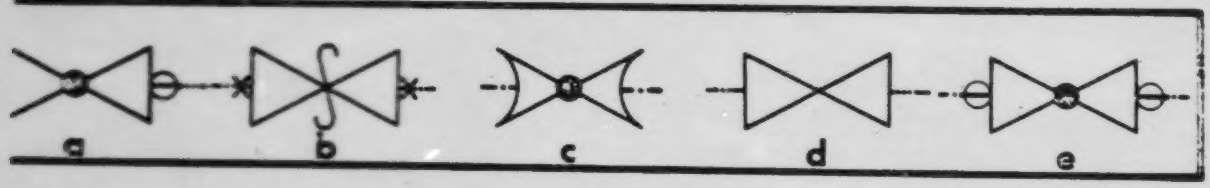
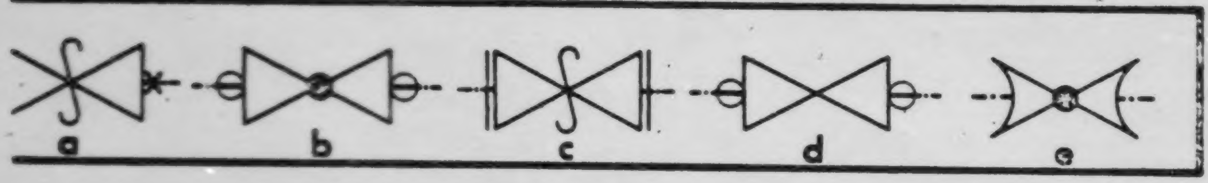
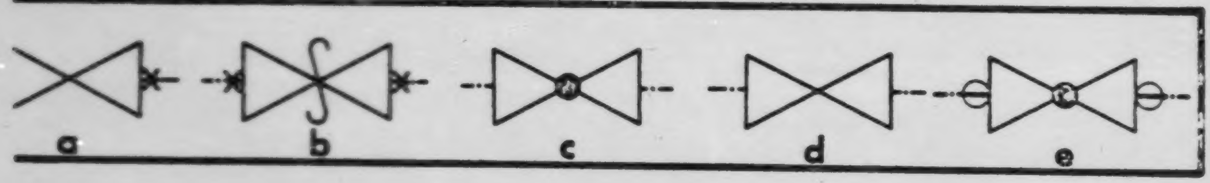
Select the gate valve that is connected to hot water pipes.



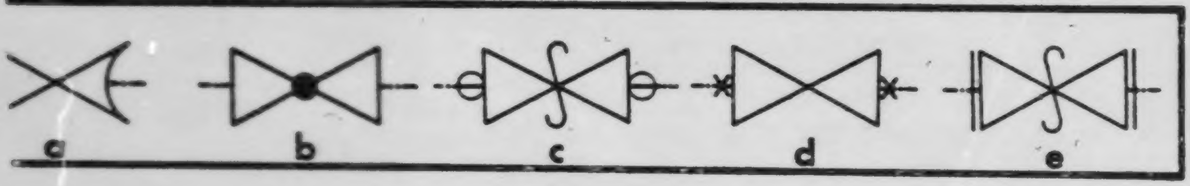
Select the safety valve that is connected to cold water pipes by welded joints.



elect the gate valve that is connected to water pipes by threaded joints.



Select the gate valve that is connected to cold water pipes by welded joints.



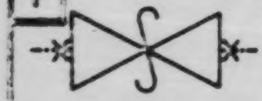
PLUMBING SYMBOL POSTTEST

Single Component Questions

Spanish

1. SELECCIONE LA VÁLVULA GLOBO UNIDA A LAS TUBERÍAS POR MEDIO DE SOLDADURA BLANDO.

1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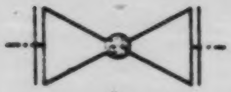
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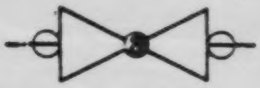
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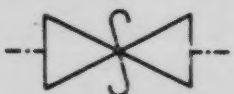
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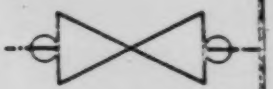
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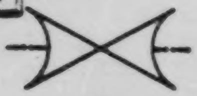
2. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DE SOLDADURA AUTÓGENA.

2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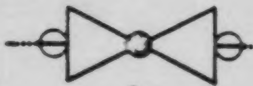
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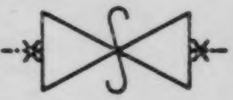
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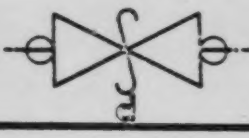
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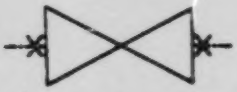
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3. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA CALIENTE POR MEDIO DE SOLDADURA BLANDO.

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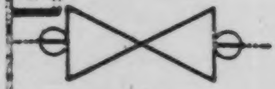
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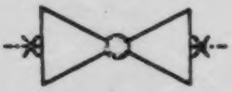
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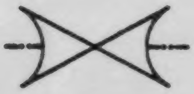
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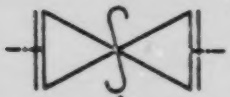
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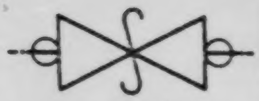
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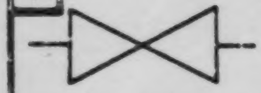
4. SELECCIONE LA VÁLVULA GLOBO UNIDA A LA TUBERÍA DE AGUA FRIA POR MEDIO SOLDADURA BLANDO.

4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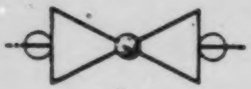
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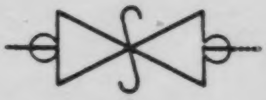
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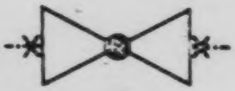
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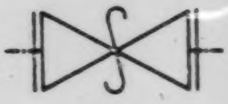
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5. SELECCIONE LA VÁLVULA GLOBO UNIDA A LA TUBERÍA DE AGUA CALIENTE.

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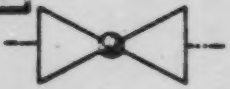
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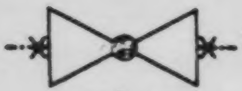
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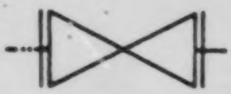
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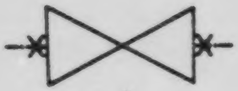
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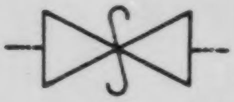
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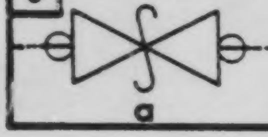
6. SELECCIONE LA VÁLVULA QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DE SOLDADURA BLANDO.

6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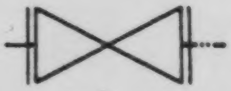
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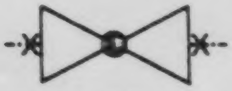
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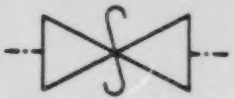
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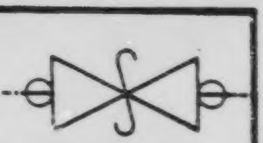
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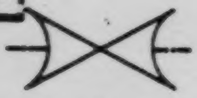
7. SELECCIONE LA VÁLVULA DE GLOBO CON UNIONES SOLDADAS CON SOLDADURA AUTÓGENA.

7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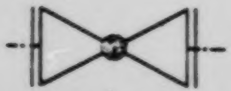
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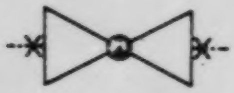
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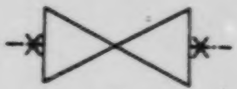
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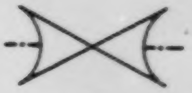
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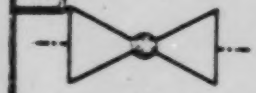
8. SELECCIONE LA VÁLVULA QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DEL SISTEMA DE ROSCAS.

8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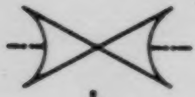
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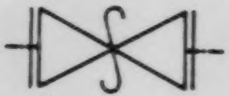
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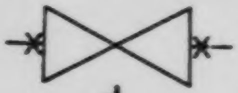
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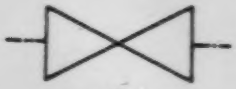
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9. SELECCIONE LA VÁLVULA DE SEGURIDAD UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DE SOLDADURA AUTÓGENA.

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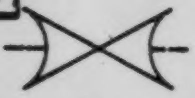
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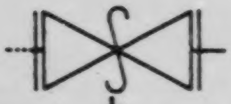
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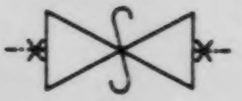
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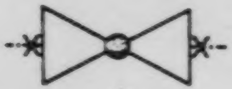
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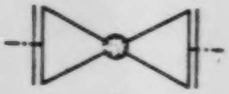
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10. SELECCIONE LA VÁLVULA DE ENTRADA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DEL SISTEMA DE ROSCA.

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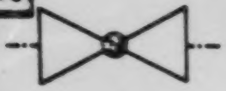
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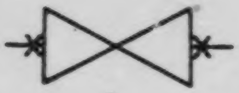
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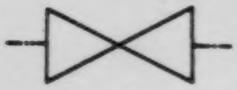
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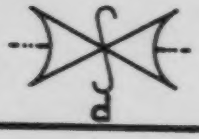
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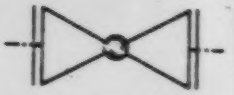
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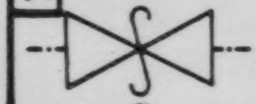
11. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DEL SISTEMA DE ROSCAS.

11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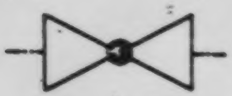
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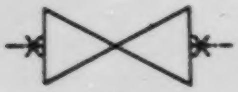
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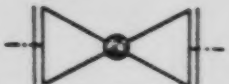
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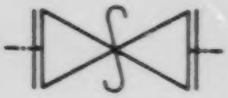
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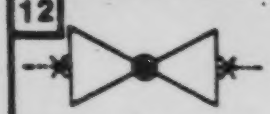
12. SELECCIONE LA VÁLVULA DE SEGURIDAD UNIDA A LA TUBERÍAS POR MEDIO SOLDADURA AUTÓGENA.

12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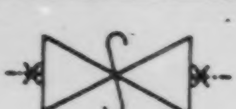
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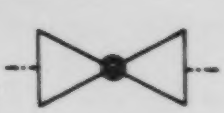
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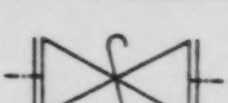
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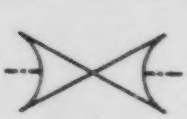
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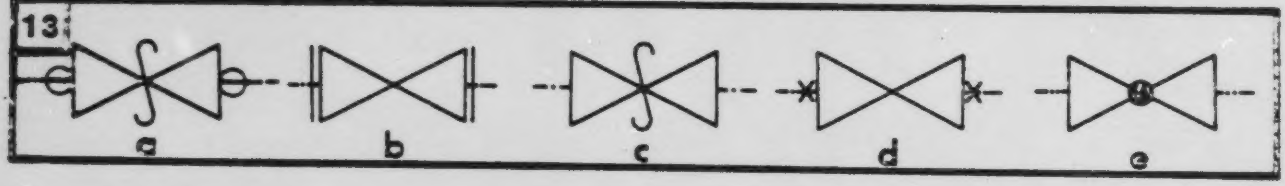
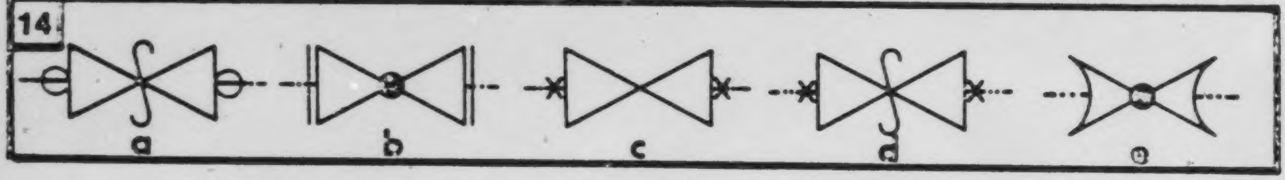
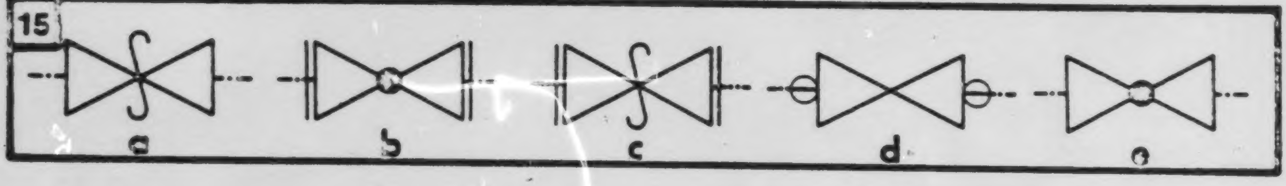
13. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA.



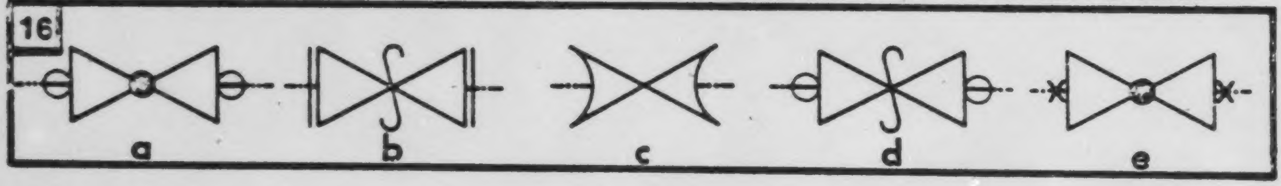
14. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DE SOLDADURA AUTÓGENA.



15. SELECCIONE LA VÁLVULA DE GLOBO QUE ESTA UNIDA A LAS TUBERÍAS POR MEDIO DEL SISTEMA DE ROSCAS.



16. SELECCIONE LA VÁLVULA GLOBO QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA FRÍA POR MEDIO DE SOLDADURA AUTÓGENA.



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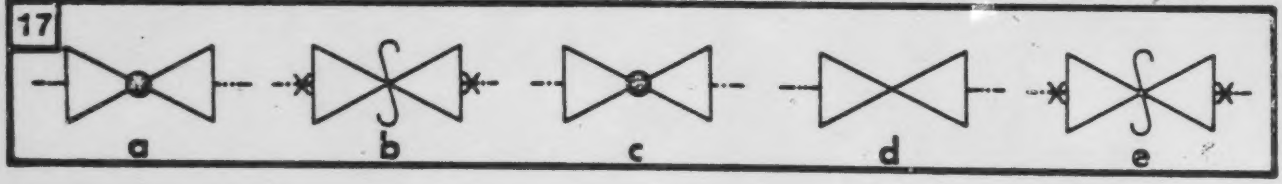

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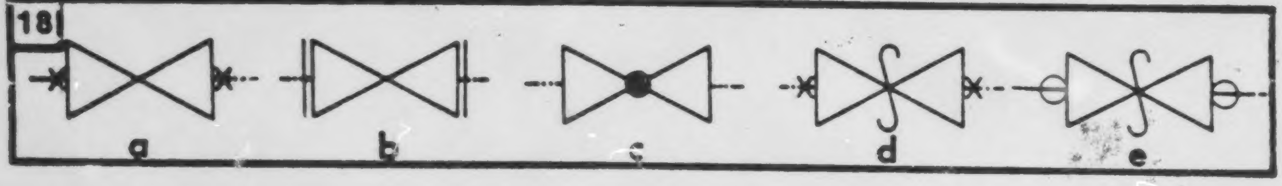
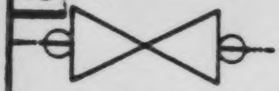


19. SELECCIONE LA VÁLVULA DE GLOBO QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DE SOLDADURA AUTÓGENA.

19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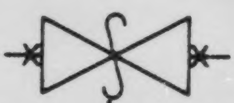
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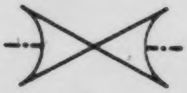
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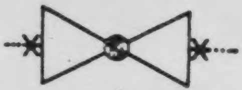
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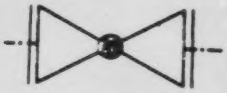
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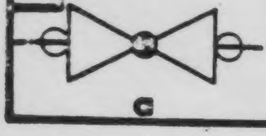
20. SELECCIONE LA VÁLVULA DE SEGURIDAD UNIDA POR SOLDADURA BLANDO.

20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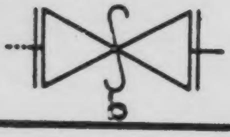
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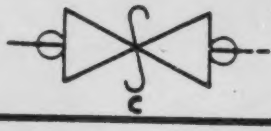
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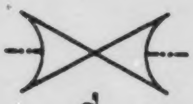
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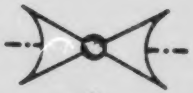
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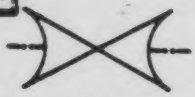
21. SELECCIONE LA VÁLVULA QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DE SOLDADURA AUTÓGENA.

21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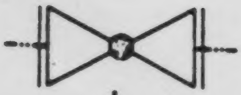
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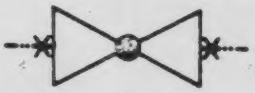
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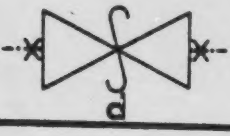
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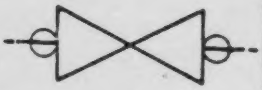
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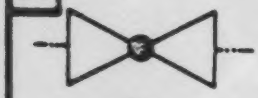
22. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA.

22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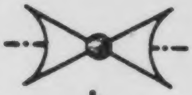
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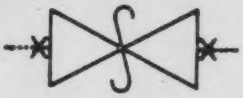
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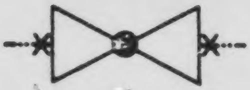
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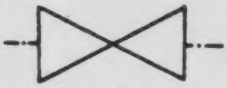
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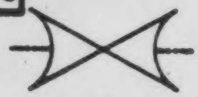
23. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DEL SISTEMA DE ROSCAS.

23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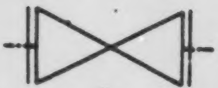
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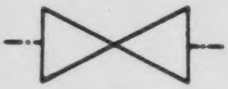
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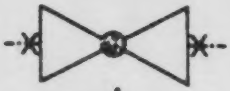
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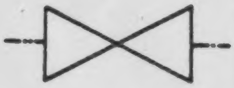
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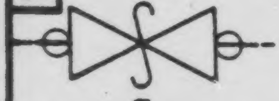
24. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DE SOLDADURA BLANDO.

24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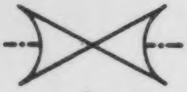
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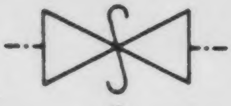
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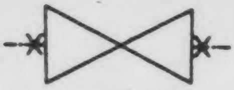
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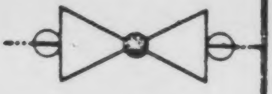
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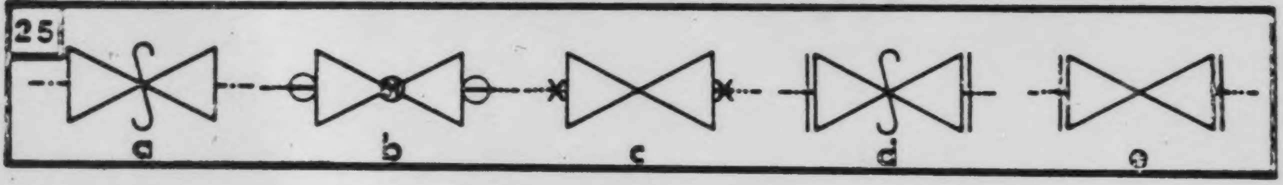
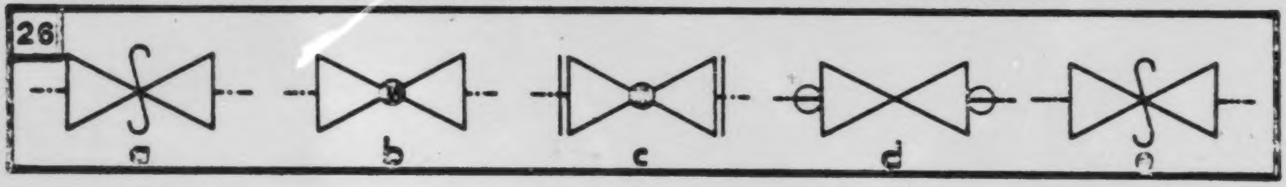
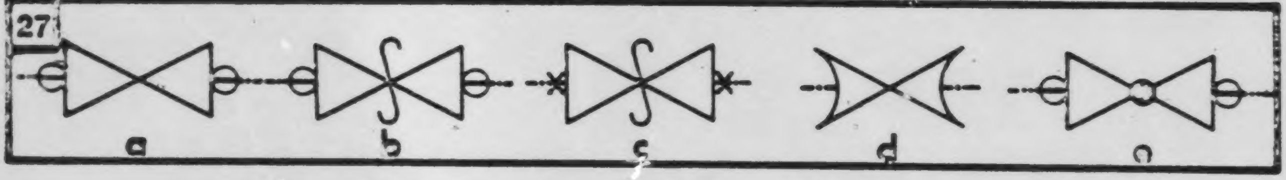
25. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DE SOLDADURA AUTÓGENA.



26. SELECCIONE LA VÁLVULA GLOBO QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA FRÍA POR MEDIO DEL SISTEMA DE ROSCA.



27. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA POR MEDIO DE SOLDADURA BLANDO.



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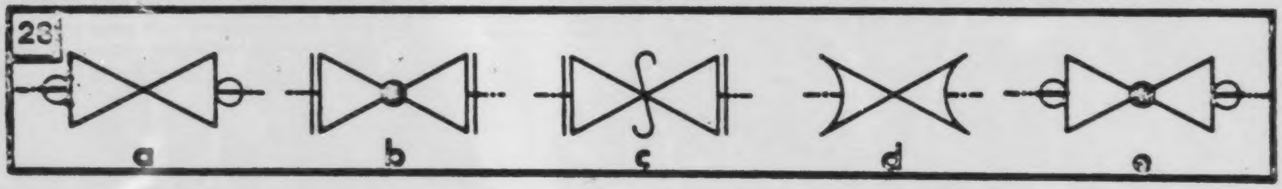
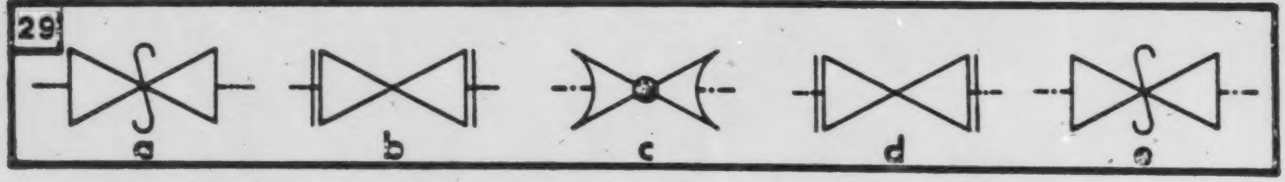
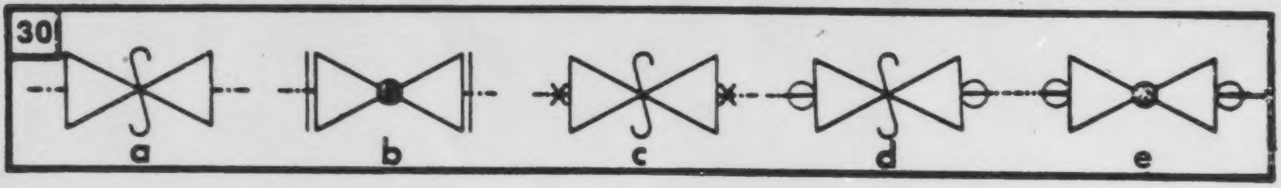


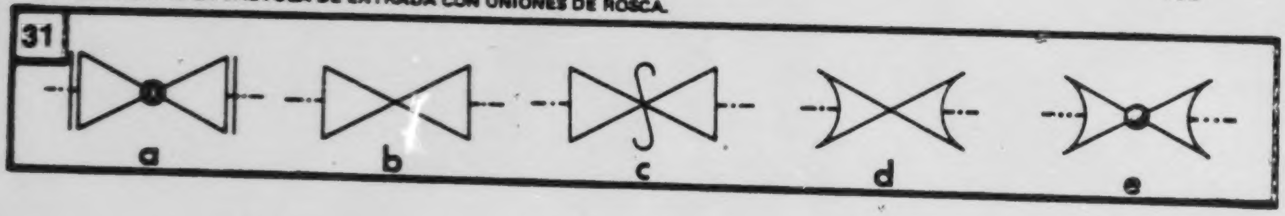
29. SELECCIONE LAS VÁLVULA QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA CALIENTE POR MEDIO DEL SISTEMA DE ROSCA.



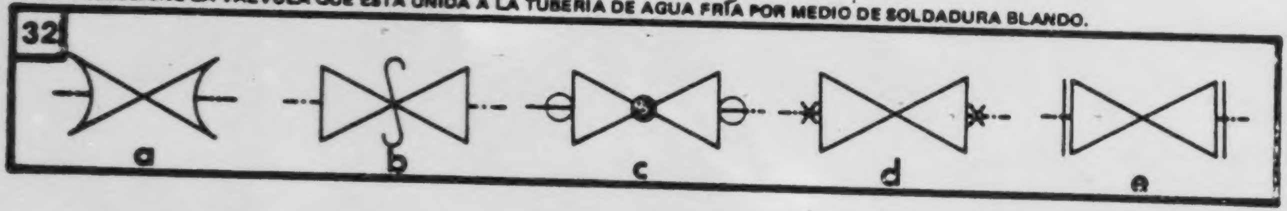
30. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA POR MEDIO DEL SISTEMA DE ROSCA.



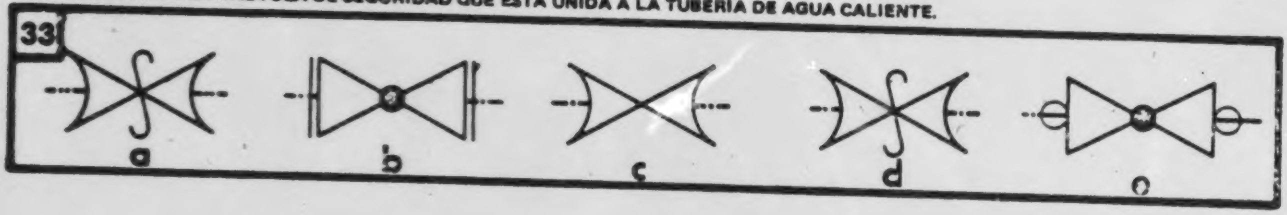
31. SELECCIONE LA VÁLVULA DE ENTRADA CON UNIONES DE ROSCA.



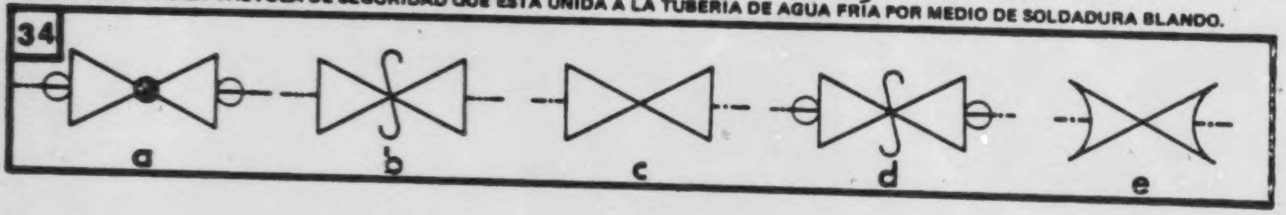
32. SELECCIONE LA VÁLVULA QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DE SOLDADURA BLANDO.



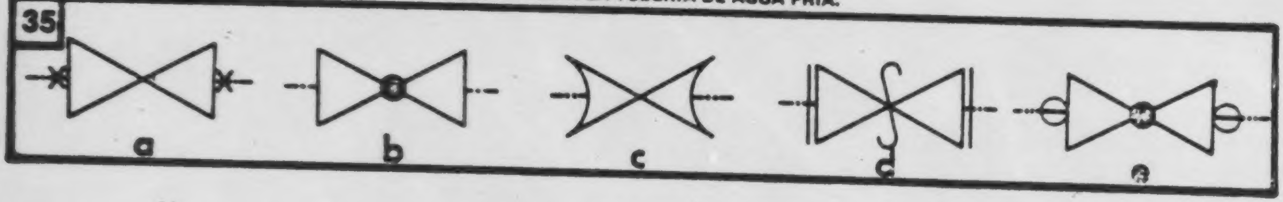
33. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE.



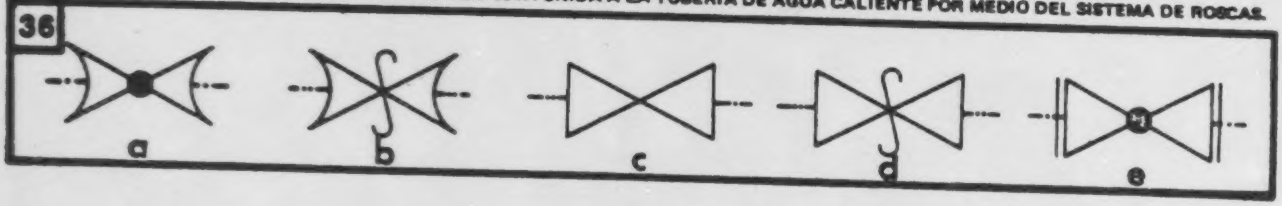
34. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DE SOLDADURA BLANDO.



35. SELECCIONE LA VÁLVULA DE GLOBO QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA.

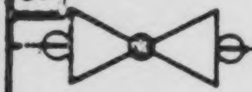


36. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LA TUBERÍA DE AGUA CALIENTE POR MEDIO DEL SISTEMA DE ROSCAS.



37. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA CALIENTE.

37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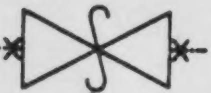
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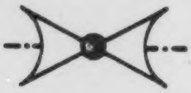
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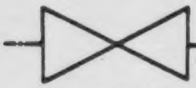
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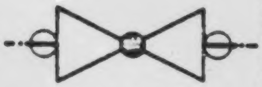
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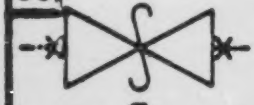
38. SELECCIONE LA VÁLVULA DE SEGURIDAD QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA FRÍA POR MEDIO DE SOLDADURA ANTÓGENA.

38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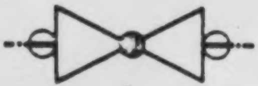
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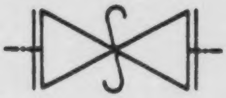
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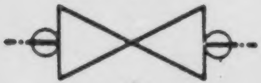
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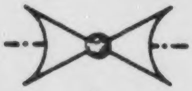
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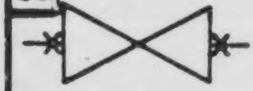
39. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LAS TUBERÍAS DE AGUA POR MEDIO DEL SISTEMA DE ROSCA.

39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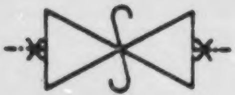
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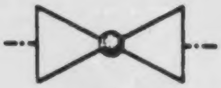
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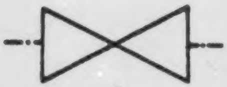
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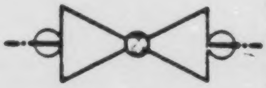
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40. SELECCIONE LA VÁLVULA DE ENTRADA QUE ESTA UNIDA A LA TUBERÍA DE AGUA FRÍA POR MEDIO DE SOLDADURA AUTÓGENA.

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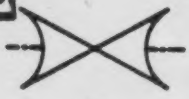
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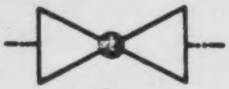
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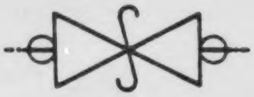
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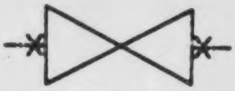
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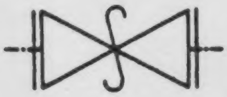
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APPENDIX C

Scripts for Instructional Materials Used in the Study

1. Bolts and screws (English version)
2. Bolts and screws (Spanish version)
3. Plumbing symbols (English version)
4. Plumbing symbols (Spanish version)

Script for Round Head Machine Screw

Look at Box A where you will see a Round Head Machine Screw. To tell the Round Head Machine Screw apart from other screws and bolts, you should look for: 1) a head that is slotted and rounded on top, 2) a bearing surface that forms a right angle with the body, 3) threads that go nearly all the way up the body, and 4) a flat base.

In Box B you can see that the top of the Round Head Machine Screw is rounded.

Observe in Box C that the head of the Round Head Machine Screw can have either a slot cut through the head, or a cross shaped recess cut into the head.

Look now at Box D. Notice that the underside of the head which we call the bearing surface is flat, and forms a right angle with the body.

The figure in Box E shows that the base of the body is flat.

Look now at Box F. Can you see that the threads of the Round Head Machine Screw go nearly all the way up the body to the head?

Notice in Box G that the Round Head Machine Screw can be long or short, wide or narrow. It can be made of bright steel, aluminum, bronze, copper or brass, and can therefore be of different colors. However, it will always have: 1) a round head that is slotted and rounded on top, 2) a bearing surface on the underside of the head that forms a right angle with the body, 3) threads that go nearly all the way up to the head, and 4) a flat base.

Turn now to Box H. Can you see that numbers 1 and 2 are somewhat the same? Notice that they both have flat bases; they both are threaded nearly the full length of the body; they both have bearing surfaces that form right angles with the body. Number 1 has flat sides around the head and no slot. Because of this, number 1 is not a Round Head Machine Screw.

Now look at Box I. Both screws look much the same: they both have flat bases; they both have round slotted heads; the bearing surfaces of both form a right angle with the body. However, number 4 is threaded only part way up the body and for this reason, cannot be a Round Head Machine Screw.

The screws shown in Box J have some parts in common also: they both have flat bases; they both have bearing surfaces which form right angles with the body; and both heads are rounded. However, there are some differences; the threads on number 6 do not go nearly to the top of the body. Furthermore, there is no slot in the head and it has a square neck. Number 6, therefore, cannot be a Round Head Machine Screw.

Box K also shows two screws which look much the same: both have threaded bodies; both have bearing surfaces which form right angles with the body; both have slots in the heads; and the tops of both heads are rounded. However, the base of number 8 is not flat, so number 8 cannot be a Round Head Machine Screw.

Look now at the screws in Box L. Can you see that none of them is a Round Head Machine Screw? Number 1 does not have threads which go nearly to the head; the bearing surface of number 2 does not form a right angle with the body; number 3 has a pointed base; number 4 has a cylindrical head; number 5 has no slot in the head. Each of these screws has something that tells us why it should not be called a Round Head Machine Screw.

Look at Box M. The screws shown here are all Round Head Machine Screws because they all have: 1) a flat base, 2) a body which is threaded nearly to the head, 3) a bearing surface which forms a right angle with the body, and 4) rounded heads that are slotted. Each example in Box M has all of the parts that a Round Head Machine Screw should have.

In Box N you can see different kinds of bolts and screws. With your pencil, encircle all those which you think are Round Head Machine Screws. Then write on the line below the box, the letters of all those you encircled. (READER: 45 second pause.) See if you have written these letters; D, F, H, I, & K. If you have all five listed and no others, you get a perfect score. If you missed some or put some down that are not Round Head Machine Screws, look over the ones you missed and see if you can tell why they are not Round Head Machine Screw.

Script for Fillister Head Cap Screw

Look now at Box A where you will see a Fillister Head Cap Screw. To tell the Fillister Head Cap Screw apart from other bolts and screws you should look for: 1) a cylindrical head that is slotted and slightly rounded on top, 2) a bearing surface that forms a right angle with the body, 3) threads that go part way or all the way up the body, and 4) a flat base.

In Box B, you can see that the top of the Fillister Head Cap Screw is slighty curved or rounded.

Observe in Box C that the head of the Fillister Head Cap Screw is cylindrical, or shaped like a drum.

Look now at Box D. Notice that the underside of the head called the bearing surface, is flat. We can say that the bearing surface forms a right angle with the body.

Look at Box E. Recall that the threads of the Fillister Head Cap Screw can either go part way up the body or all the way up the body to the head.

Now look at Box F. Here we can see that the Fillister Head Cap Screw can be long or short, wide or narrow. It can be made of black steel, bright steel, aluminum, bronze, copper or brass, and, therefore, can be different colors. However, it will always have: 1) a cylindrical head that is slotted and rounded on top, 2) a bearing surface on the underside of the head that forms a right angle with the body, 3) threads that go part way or all the way up to the head, and 4) a flat base.

Turn now to Box G. Can you tell that numbers 1 and 2 are somewhat the same? Notice that they both have flat bases; they both are threaded the full length of the body; they both have slots in the head. Number 1 has a bearing surface that forms a right angle with the body, but number 2 has a bearing surface that is not at right angles with the body, nor is the head on number 2 dome-shaped or slightly rounded. Because of this number 2 is not a Fillister Head Cap Screw.

Now look at Box H. Both screws look much the same: they both have flat bases; they are both threaded for the full length of the body; the bearing surface of each is at right angles to the body. However, number 3 does not have a cylindrical head nor is the head slotted. So number 3 cannot be a Fillister Head Cap Screw.

Glance at Box I. These two screws are also somewhat the same. Observe that: they both have flat bases; they both have threaded parts and unthreaded parts of the body; they both have a bearing surface that forms a right angle with the body; they both have slots in the heads; the tops of both heads are rounded. However, the head of number 6 is not cylindrical like a drum, so number 6 cannot be a Fillister Head Cap Screw.

Look now at the screws in Box J. None of them is a Fillister Head Cap Screw. Number 1 has a flat top on the head, and the head is not cylindrical. Number 2 does not have a cylindrical head, and number 3 has a bearing surface that does not form a right angle with the body. Each of these screws has a part that tells us it is not a Fillister Head Cap Screw.

The screws shown in Box K all have: 1) a flat base, 2) threads which go part way or all the way up the body, 3) a bearing surface which forms a right angle with the body, and 4) a cylindrical or drum-shaped head which is slightly rounded on top and slotted. Each example in Box K has all of the parts that a Fillister Head Cap Screw should have.

In Box L you can see different kinds of bolts and screws. With your pencil, encircle all of the ones you think are Fillister Head Cap Screws. Then on the line below the box, write the letters of all those you encircled. (READER: 45 second pause.) See if you have written these letters: B, D, & G. If you have all three listed and no others, you get a perfect score. If you missed some or put some down that are not Fillister Head Cap Screws, look over the ones you missed and see if you can tell why they are not Fillister Head Cap Screws.

Script for Hexagon Head Bolt

In Box A you are looking at a Hexagon Head Bolt. To tell the Hexagon Head Bolt apart from other bolts and screws, you should look for five things: 1) a head with six flat sides, 2) a top surface that is flat, 3) a bearing surface that is square to the body, 4) a body that is partly threaded and partly unthreaded, and 5) a flat base.

In Box B you can see that the top surface of the Hexagon Head Bolt is flat.

In Box C observe that the bearing surface (or the underneath part of the head) is flat and at right angles with the body.

Look at Box D. Can you see that the head of the Hexagon Head Bolt has six flat sides? The word hexagon means six sides.

In Box E notice that the base of the body of the Hexagon Head Bolt is flat, it does not come to a point.

In Box F we can see that the upper part of the body of the Hexagon Head Bolt does not have threads, but the lower part does have threads.

Take a look at the Hexagon Head Bolts in Box G. You can see that they can be long or short, wide or narrow and can come in different shades and colors. However, they will always have:
1) a head with six sides, 2) a head with a flat top surface,
3) a bearing surface that forms a right angle with the body,
4) a body that is partly threaded and partly unthreaded, and
5) a flat base.

Both bolts shown in Box H have flat bases, partly threaded bodies, and a bearing surface that forms a right angle with the body. However, can you see that number 2 does not have six flat sides on the head nor a head with a flat top surface? Number 2 is not a Hexagon Head Bolt.

Look now at Box I. Notice that: the top surface of each head is flat; each head has six sides; the bearing surface of each bolt forms a right angle with the body; the body of each is partly threaded and partly unthreaded. Because the base of number 4 is pointed it cannot be a Hexagon Head Bolt.

In Box J we see that the top surfaces of both bolts have flat surfaces, six sided heads. bearing surfaces which form right angles with the bodies, and flat bases. But the threads on number 5 go from to to bottom. Number 5, therefore, is not a Hexagon Head Bolt.

Now look at the five bolts and screws in Box K. Can you tell why none of them is a Hexagon Head Bolt? The reasons are as follows: number 1 has threads along the whole body, number 2 does not have a six-sided head, nor is it flat on top of the head, number 3 has a pointed base and the threads go from top to bottom, number 4 also has a pointed base, and number 5 has a round head and a square neck.

The bolts in Box L are all Hexagon Head Bolts. Although they are different lengths, widths and colors, they all have:

six-sided, flat-topped heads, a bearing surface which forms a right angle with the body; a partly threaded and partly unthreaded body, and a flat base.

Box M contains drawings of many screws and bolts. Draw a line around all the ones which you thing are Hexagon Head Bolts. Write on the line at the bottom of the page the letters of all the ones you encircled. (READER: 45 second pause.) Have you written these letters - D, E, & I? If you have all three listed and no others, you have a prefect score. If you missed some or put down some that are not Hexagon Head Bolts, look over the ones you missed and see if you can tell why they are not Hexagon Head Bolts.

Script for Plumbing Symbols

Please open the booklet to the first page. Here you will see a message entitled "To The Student."

TO THE STUDENT

In this booklet, you will be learning to identify the symbols for three types of valves used in the plumbing trade. In addition, you will learn the symbols for three types of pipe joints.

Thank you for trying to learn these symbols. By doing so, you are helping us to learn how to be better teachers. Thank you, too, for doing the best you can. Now turn to Set A, The Globe Valve.

SET A

THE GLOBE VALVE

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B, notice that a round dot placed in the center of the crossed lines is the symbol for a globe valve.

In Box C is the symbol for glove valve--a set of crossed lines with a large dot in the middle.

The symbol for the globe valve comes in different kinds of ends as shown in the bottom part of Box D, but it will always have the set of crossed lines with the large dot in the middle as shown in the top part of Box D.

Symbol #1 in Box E is a glove vlave because it has crossed lines with a large dot in the middle. Number 2 is not the symbol for a globe valve because it does not have a dot in the middle of the crossed lines.

Symbol #1 in Box F is not the symbol for a globe valve because it does not have a dot in the middle of the crossed lines. Number 2 is the symbol for a globe valve because it has crossed lines with a large dot in the middle.

None of the valve symbols in Box G are symbols for the globe valve because they do not have the dot in the middle of crossed lines.

All of the valve symbols in Box H are symbols for the globe valve because they have the two necessary parts: (1) a set of crossed lines, and (2) a dot in the middle of the crossed lines.

In Box I, there are several different types of valve symbols. Select all of the valve symbols that you think are symbols for the globe valve. Put your answers on the answer sheet provided. Please do not make any marks in the booklet.

SET B

THE SAFETY VALVE

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B, notice that a big "S" placed in the center of the crossed lines is the symbol for safety valve.

In Box C is the symbol for a safety valve--a set of crossed lines with an S-shape in the middle.

The symbol for the safety valve can have different types of ends as shown in the bottom part of Box D, but it will always have the set of crossed lines with the S-shape in the center where the lines cross each other as shown in the top part of Box D.

Symbol #1 in Box E is not the symbol for a safety valve because it does not have the S-shape in the middle. Symbol #2 is the symbol for a safety valve because it has the crossed lines and the S-shape in the center.

Symbol #1 in Box F is the symbol for the safety valve because it has the S-shape in the middle. Symbol #2 is not the symbol for a safety valve--it does not have the S-shape.

None of the valve symbols in Box G are symbols for the safety valve because they do not have the S-shape in the center.

All of the valve symbols in Box H are symbols for the safety valve because they have the two necessary parts: (1) a set of crossed lines, and (2) an S-shape in the center of the crossed lines.

In Box I, there are several different types of valve symbols. Select all of the valve symbols that you think are the symbols for the safety valve. Put your answers on the answer sheet provided. Please do not make any marks in the booklet.

SET C

THE GATE VALVE

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B, notice that the symbol for a gate valve is a set of crossed lines with nothing in the middle.

They symbol for the gate valve can have several types of ends as shown in Box C, but it will always have the crossed lines with nothing in the middle.

Symbol #1 in Box D is the symbol for a gate valve because it has crossed lines with nothing in the middle; number 2 is not the symbol for a gate valve because it has something in the middle of the crossed lines.

Symbol #1 in Box E is not the symbol for a gate valve because it has a dot in the middle of the crossed lines; #2 is the symbol for the gate valve because it has crossed lines with nothing in the middle.

None of the valve symbols in Box F is a gate valve symbol because each symbol has something in the middle of the crossed lines.

All of the valve symbols in Box G are symbols for the gate valve because they have the crossed lines with nothing in the middle where the lines cross.

In Box H there are several different types of valve symbols. Select all of the valve symbols that you think are the symbols for the gate valve. Put your answers on the answer sheet provided. Please do not make any marks in the booklet.

SET D

THE WELDED JOINT

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B you can see that by looking at the ends of a valve symbol, we can tell how a particular valve is fastened or hitched to the pieces of pipe that connect to the valve.

There are five different ways to connect pieces of pipe to a valve. We are going to teach you the symbols for three of the ways for joining pipes to valves. In Box C, you can see pipe joints that have been welded. The symbol for a welded joint is an "X" across the lines which show where the pipe connects to the valve--think of the "X" as being a spark--when the pipe is welded, sparks fly everywhere near the spot where the pipe is being welded; so an "X" tells us that the piping is welded to the valve.

In Box D, you can see that if a valve is to be welded to a pipe, the X-shape (or spark shape) will be put on the lines at the end of the symbol.

Symbol #1 in Box E has joints that have been welded because the X-shape has been placed on the lines leading into the ends of the symbol; #2 has not been welded because it does not have the "X's" on the lines leading to the two ends of the symbol.

Symbol #1 in Box F has joints which have not been welded because they do not have "X's" on the lines at the two ends of the symbol; symbol #2 does not have joints that have been welded because there are no "X's" on the lines leading to the ends of the symbol; the joints for symbol #3 have been welded because there are "X's" on the lines leading to the two ends of the symbol.

None of the joints for the symbols in Box G have been welded because they do not have "X's" placed on the lines leading to the ends of the symbol.

All of the joints for the valve symbols in Box H have been welded because they each have "X's" on the lines leading to the ends of the symbols.

In Box I, select all of the valve symbols with joints in which the valve has been welded to the lead-in pipes. Put your answers on the answer sheet provided. Please do not make any marks in the booklet.

SET E

THE SOLDERED JOINT

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B you can see that by looking at the ends of a valve symbol, we can tell how a particular valve is fastened or hitched to the pieces of pipe that connect to the valve.

There are five different ways to connect pieces of pipe to a valve. In Box C you can see the symbol for a pipe joint that has been soldered. The symbol for a soldered joint is an "O" across the lines that lead into the two ends of the valve symbol. Think of the circles as beads that are formed when the joint is soldered. All types of valves can be soldered as shown in Box D. When a valve is to be soldered to a piece of pipe, the symbol will have circles placed on the lines leading into the ends of the symbol.

Symbol #1 in Box E has joints that have not been soldered because circles have not been placed on the lines which lead into the ends of the symbol. Symbol #2 has joints which have been soldered because it has circles on the lines leading into the valve symbol. Symbol #3 has joints that have not been soldered because circles have not been placed on the lines which lead into the ends of the symbol.

Symbol #1 in Box F shows two joints that have been soldered, because circles have been placed across the lines that lead into the valve; symbol #2 does not have soldered joints because it does not have the circles across the two ends of the symbol; symbol #3 does not have soldered joints because it does not have the circles across the lines that lead into the symbol.

None of the joints for the symbols in Box G have been soldered because they do not have the circles placed on the lines leading into the ends of the valve symbol. All of the joints for the valve symbols in Box H will be soldered joints because circles have been placed on the lines leading into the valve symbols.

In Box I, select all of the valve symbols with joints in which the valve has been soldered to the lead-in pipes. Put your answer on the answer sheet provided. Please do not make any marks in the booklet.

SET F

THE THREADED JOINT

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B you can see that by looking at the ends of a valve symbol, we can tell how a particular valve is fastened or hitched to the pieces of pipe that connect to the valve.

There are five different ways to connect pieces of pipe to a valve. In Box C, you can see the symbol that is used to show that pieces of pipe will be joined to a valve with the use of threads. Or in other words, that the pipe will be screwed into the valve openings. The symbol to show that a piece of pipe has been joined by threads to a valve is a single perpendicular line at the end of the valve symbol. When joints are to be threaded, the lead-in lines which join the lines of the valve symbol will not have crosses or circles on them.

In Box D different types of valves are shown connected to pieces of pipe by threads. The lead-in lines will not have any circles or crosses.

Symbol #1 in Box E has joints that are threaded together because there is a single up-and-down or perpendicular line at the ends of the symbol and there are no crosses or circles on the lines leading into the valve symbol. Symbol #2 has joints which are not threaded because there are double lines at the ends of the symbols.

Symbol #1 in Box F has joints which have not been connected by threads. The crosses or "X's" on the lines leading into the ends of the symbol shows that these joints have been welded instead of connected by threads. Valve symbol #2 has joints that are connected by threads; valve symbol #3 has joints that are connected by solder as shown by the circles on the lines leading into the ends of the valve symbol.

None of the symbols in Box G show pipes joined to the valves by threads.

All of the symbols in Box H show pipes joined to the valves by threads. There are no "X's" or circles on the lead-in lines, and the ends of the valve are perpendicular to the lead-in lines.

In Box I, select all of the valve symbols which show lead-in pipes which are joined to valves by threads. Put your answers on the answer sheet provided. Please do not make any marks in the booklet.

SET G

THE COLD WATER PIPE

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B you can see that by looking at the ends of a valve symbol, we can tell how a particular valve is fastened or hitched to the pieces of pipe that connect to the valve.

By looking at the plumbing symbol in Box C, we can tell what type of valve is to be used. We can also tell how the lead-in pipe is fastened to the valve. Finally, we tell if the pipe leading into the valve is for hot water or cold water.

In Box D, the two arrows are pointing to the pipe lines that lead into the valve. By looking at the lines leading into the ends of the valve symbol, we can tell if they are made for hot water or for cold water.

In Box E is a cold water pipe which is shown by a broken lead-in line that is made up of a dash followed by a single dot.

In Box F, all of the valves have cold water pipes leading into them because the lead-in lines are made up of dashes followed by a single dot.

In Box G, valve symbol #1 has a cold water pipe leading into it because it is a dash followed by a dot. Remember the symbol for a cold water pipe is dash-dot, dash-dot, dash-dot. Symbol #2, therefore, does not show a cold water pipe leading into the valve because it has dashes followed by two dots instead of one.

None of the valve symbols in Box H show cold water going into the valve because none of them are made up of a dash followed by just one dot.

All of the valve symbols in Box I show cold water going into the valve because the lead-in lines are made up of a dash followed by just one dot.

In Box J, select all of the valve symbols which show cold water lead-in pipes. Put your answers on the answer sheet provided. Please do not make any marks in the booklet.

SET H

THE HOT WATER PIPE

In Box A you can see the symbol for a valve. A valve is shown as a set of crossed lines.

In Box B you can see that by looking at the ends of the valve symbol, we can tell how a particular valve is fastened or hitched to the pieces of pipe that connect to the valve.

By looking at the plumbing symbol in Box C, we can tell what type of valve is to be used. We can also tell how the lead-in pipe is fastened to the valve. Finally, we tell if the pipe leading into the valve is for hot water or cold water.

In Box D, the two arrows are pointing to the pipe lines that lead into the valve. By looking at the lines leading into the ends of the valve symbol, we can tell if they are made for hot water or for cold water.

In Box E, a hot water pipe is shown by a broken lead-in line that is made up of a dash followed by two dots.

In Box F, all of the valves have hot water pipes leading into them because the lead-in lines are made up of dashes followed by two dots.

In Box G, valve symbol #1 has a hot water pipe leading into it because it has dashes followed by two dots. Remember that the symbol for a hot water pipe is dash-dot-dot, dash-dot-dot, dash-dot-

dot. Symbol #2, therefore, does not show a hot water pipe leading into the valve because it has dashes followed by one dot instead of two.

None of the valve symbols in Box H show hot water going into the valve because none of them are made up of a dash followed by two dots.

All of the valve symbols in Box I show hot water going into the valve because the lead-in lines are made up of a dash followed by two dots.

In Box J, select all of the valve symbols which show hot water lead-in pipes. Put your answers on the answer sheet provided. Please do not make any marks in the booklet.

Tornillo con Cabeza Redonda para Marquinaria

Observe en la casilla A donde verá usted un tornillo de cabeza redonda. Para diferenciarlo de otros tornillos y pernos usted deberá siempre buscar estas caracteristicas: (1) cabeza redondeada con una ranura al centro, (2) superficie de apoyo que forma un ángulo recto, (3) superficie cubierta casi completamente por roscas, y (4) terminación plana.

En la casilla B observará que la cabeza del tornillo es redondeada.

En la casilla C observe que la cabeza de este tornillo podrá tener una ranura al centro o una cruz o estrella.

Mire a la casilla D. Notará que la parte de abajo de la cabeza, lo que llamamos superficie de apoyo es plana y forma un ángulo recto con el resto del cuerpo del tornillo.

La figura en la casilla E muestra que la base o terminación del tornillo es plana.

Observe la casilla F. ¿Nota que la roscas en este tornillo cubren casi todo el cuerpo del tornillo?

Notará que en la casilla G el tornillo de cabeza redonda podrá ser más largo o corto, ancho, o estrecho. Podrá estar fabricado con acero, aluminio, estano, cobre or bronce, y por esto tendrá diferentes colores. Sin embargo siempre tendrán estos tornillos algunas caracteristicas iguales como: (1) cabeza redondeada con una ranura en la parte superior, (2) superficie de apoyo que forma un ángulo recto con el cuerpo del tornillo, (3) rosca que cubre casi todo el cuerpo del tornillo, y (4) terminación plana.

Voltee la página a la casilla H. ¿Nota usted que el #1 y #2 se asemejan? Los dos tornillos tienen terminaciones planas, el cuerpo está casi todo cubierto por rosca, los dos teinen superficie de apoyo que forman ángulo recto. El #1 tiene lados planos alrededor de la cabeza y no tiene ranura en la parte superior, por esto el #1 no es un Tornillo de Cabeza Redonda para Maquinaria.

Observe la casilla I. Los dos tornillos se parecen: Los dos tienen terminaciones planas, tienen cabeza redondeada y ranura en la parte superior, la superficie de apoyo forman un ángulo recto con el cuerpo. Sin embargo el #4 está cubierto de rosca parcialmente y por esta razón, no puede ser un Tornillo de Cabeza redonda para Maquinaria.

Los tornillos que se enseñan en la casilla J tienen algunas partes en común: Los dos terminan en forma plana, tienen superficies de apoyo formanado un ángulo recto con el cuerpo del tornillo y las cabezas son redondeadas. Sin embargo, hay algunas diferencias; las roscas en el #6 no cubren el cuerpo del tornillo, además no tiene ranura en la parte superior de la cabeza y su cuello es cuadrado. Por esto podemos decir que el #6 no es un Tornillo Redondo para Maquinaria.

La casilla K enseña dos tornillos que se parecen: Los dos tienen roscas cubriendo casi todo el cuerpo; tienen superficies de apoyo formanado ángulo recto con el cuerpo; tienen ranuras en las cabezas, y la parte superior de las cabezas son redondeadas. Sim embargo, la terminación del #8 no es plana, por eso podemos decir que #8 no es un Tornillo de Cabeza Redonda para Maquinaria.

Mire a los tornillos en la casilla L. ¿Se da cuenta usted que ninguno de ellos es Tornillo de Cabeza Redonda para Maquinaria? El #1 no tiene roscas sobre toda la superficie del tornillo; en el #2 la superficie de apoyo no forma un ángulo recto con el cuerpo del tornillo; #3 tiene terminación puntiaguda; el #4 tiene cabeza cilíndrica: el #5 no tiene ranura sobre la superficie superior de la cabeza. Cada uno de estos tornillo tienen algo que indican que no se pueden clasificar como de la clase Tornillos de Cabeza Redondeada para Maquinaria.

Observe en la casilla M. Los tornillo que se enseñon aqui son todos de la clase Tornillos de Cabeza Redonda para Maquinaria porque todos ellos tienen: (1) una terminación plana, (2) superficie cubierta casi toda por roscas, (3) superficie do apoyo que forma un ángulo recto con el cuerpo del tornillo, (4) cabeza redondeada con una ranura en la parte superior. Todoa los tornillos en la casilla M tienen las cosas para poder ser llamados Tornillos de Cabeza Redonda para Maquinaria.

En la casilla N se enseñor diferentes clases de pernos y tornillos. En su hoja de respuesta, haga un círculo a las letras que usted crea que enseñor esta clase de tornillo. Si usted escogió las letras D, F, H, I, & K, escogió bien. Si fallo alguna o escogió alguna equivocada mire de nuevo los tornillo y pernos nota de la diferentes partes que enseñor que esos no son Tornillos de Cabeza Redonda para Maquinaria.

Tornillo de Cabeza Guillane o Fillister

Observe la casilla A donde se ilustra un tornillo de cabeza guillane o fillister. Para diferenciar un tornillo de la clase de cabeza guillane o fillister de otras clases de tornillos y pernos, usted debe buscar las siguientes cosas (1) Cabeza cilíndrica con un ranura superior y cabeza ligeramente curveada, (2) superficie de apoyo que forma un ángulo recto con el cuerpo del tornillo, (3) roscas que cubren la superficie del tornillo parcialmente y (4) una terminación plana.

En la casilla B podrá usted observar que la superficie superior de este tornillo es ligeramente curvadao redonda.

Observe en la casilla C que la ilustración de esta clase de tornillo es cilíndrica, o en forma de tambor.

Observe ahora la casilla D. Notará que la parte de abajo de la cabeza, lo que llamamos superficie de apoyo, es plana. Podemos decir que la superficie de apoyo forma un ángulo recto con el resto del tornillo.

Observe en las casilla E. Recuerde esto, las roscas pueden cubrir total o parcialmente la superficie en esta clase de tornillo.

Observe la casilla F. Aquí usted verá que el tornillo de cabeza guillane o fillister puede ser largo o corto, ancho o estrecho, puede ser fabricado de acero negro, acero brilloso, aluminio, estano, cobre, o bronce, y que por esa razón su color puede variar. Sim embargo esta clase de tornillo siempre tendra las mismas cosas, o sea: (1) cabeza cilíndrica redondeada y con ranura, (2) superficie de apoyo debajo de la cabeza que forma un ángulo recto, (3) roscas que cubre parcial o totalmente la superficie del tornillo, (4) una terminación plana.

Observe la casilla G. ¿Podrá usted decir que el número 1 y 2 son los mismos? Note que los dos terminan en forma plana; tienen rosca cubriendo la superficie totalmente; y tienen ranura en la parte superior. El #1 tiene una superficie de apoyo que forma un ángulo recto con el cuerpo del tornillo, pero el #2 tiene una superficie de contacto que no forma ángulo recto con el cuerpo del tornillo, además la cabeza del el #2 no es en forma de cúpula o sea redondeada. Por esto podemos decir que el #2 no es un tornillo de cabeza guillane o fillister.

Observe la casilla H. Los dos tornillos se parecen los dos tienen terminación plana; la superficie de los dos eata cubierta de roscas; la superficie de contacto forma un ángulo recto con el cuerpo del tornillo. Sin embargo el #3 no tiene cabeza cilíndroca ni tiene ranura, por lo tanto el #3 no se puede clasificar como un tornillo de cabeza guillane o fillister.

Observe la casilla I. Estos dos tornillos se parecen mucho. Mire que: los dos tienen terminaciones plana; la superficie de los dos eatá cubierta parcialmente de roscas; los dos tienen superficie de contacto que forman ángulo recto; la cabeza de los dos tornillos es redondeada. Sin embargo la cabeza del #6 no es cilíndrica como un tambor, por lo que podemos decir que el #6 no es un tornillo de cabeza guillane o fillister.

Mire los tornillos en la casilla J. Ninguno de ellos es tornillo de cabeza guillane o fillister. Porque el número 1 tiene la cabeza plana y no es cilíndrica. Numero 2 no tiene cabeza cilíndrica, y numero 3 tiene una superficie de apoyo que no forma un ángulo recto con el cuerpo del tornillo. Cada uno de estos tornillos tienen una cosa que nos dice que no son tornillos de cabeza guillane o fillister.

Los tornillos ilustrados en la casilla K tienen todos: (1) tienen terminaciones planas, (2) superficie cubierta parcial o totalmente de roscas, (3) superficie de apoyo que forma un ángulo recto con el cuerpo del tornillo, (4) cabeza en forma cilíndrica o forma de tambor ligeramente redondeada o curva y una ranura superior. Todas las ilustraciones en la casilla K tienen todas las cosas que nos hacen poder decir que son de la clase tornillos de cabeza guillane o fillister.

En la casilla L podrá usted observar diferentes clase de tornillos y pernos. En su hoja de respuestas, haga un círculo en las letras que indican que la ilustración respectiva es un tornillo de cabeza guillane o fillister . Si usted marco las letras B, D, & G escogio bien, pero si usted no marcó alguna de estas letras o marcó otra letra que no indique esta clase de tornillo trate de determinar porque estos no son tornillos de la clase tornillos de cabeza guillane o fillister.

Tornillo De Cabeza Hexagonal

En la casilla A observe un tornillo hexagonal. Para diferenciar un tornillo hexagonal de otras clases de tornillos y pernos, usted deberá buscar siempre las siguientes cosas: (1) una cabeza con seis lados planos, (2) la superficie superior de la cabeza deberá ser plana, (3) la superficie de apoyo deberá ser cuadrada en relación con el cuerpo del tornillo, (4) el cuerpo del tornillo debe tener roscas en la parte inferior y sin roscas en la parte superior, y (5) la terminación debe ser plana.

En la casilla B podrá usted ver la superficie superior de la cabeza de un tornillo hexagonal que es plana.

En la casilla C observará que la superficie de spoyo (o parte inferior de la cabeza es plana y forma un ángulo recto con el cuerpo.

En la casilla D observará que la cabeza del tornillo hexágono tiene seis lados planos, la palabra hexagonal significa seis lados.

En la casilla E notará usted que la base del cuerpo del tornillo, o sea la terminación de este, es plana, o no sea termina en forma de punta.

En la casilla F podrá usted observar que la parte superior del cuerpo del tornillo hexagonal no tiene roscas, pero que la parte inferior si las tiene.

Observe los tornillos hexagonales en la casilla G. Podrá usted observar que esta clase de tornillo puede ser largo o corto, ancho, o estrecho, y que se fabrican en diferentes clases de forma y color. Pero todos los tornillos hexagonales tendrán: (1) cabeza con seis lados, (2) la cabeza con una superficie plana, (3) una superficie de apoyo que forma un ángulo recto con el resto del tornillo, (4) un cuerpo que en parte tiene roscas y en parte no, y (5) terminación plana.

Ambos pernos ilustrados en la casilla H tienen terminación plana, rosca en parte del tornillo, y una superficie de apoyo que forma un ángulo recto con el cuerpo. Sin embargo, observe que la ilustración #2 no tiene cabeza con seis lados o una superficie superior plana. Podemos decir pues, que el tornillo #2 no es de la clase hexagonal.

Observe la casilla I. Note que: la parte superior de la cabeza es plana; cada cabeza tiene seis lados; la superficie de apoyo de cada perno o tornillo forma un ángulo recto con el cuerpo del tornillo; el cuerpo del tornillo está cubierto de roscas parcialmente, pero porque la terminación del #4 es puntiaguda, no puede ser un tornillo hexagonal.

En la casilla J observe que la superficie superior de la cabeza de ambos tornillos es plana, tiene seis lados la cabeza, superficie de apoyo formando ángulo recto y terminación plana. Pero la rosca en el #5 cubren de arriba hasta abajo, por eso podemos decir que el #5 no es un tornillo hexagonal.

Ahora observe los seis pernos y tornillos en la casilla K. ¿Puede decir usted porque no son estos tornillos hexagonales? Las razones son las siguientes: #1 tiene rosca de arriba a abajo, #2 no tiene cabeza con seis lados, ni está plano en la superficie superior,

#3 tiene una terminación puntiaguda y la rosca cubre toda la superficie, #4 tambien termina en forma puntiaguda, y #5 tiene cabeza redondeada y cuello cuadrado.

Los pernos en la casilla L son todos hexagonales. Todos tienen una largura anchura y color diferentes, pero tienen en común: cabeza con seis lados, plana, superficie de apoyo en forma de ángulo recto, rosca parcialmente cubriendo el cuerpo del tornillo, terminación plana.

La casilla M contiene dibujos de muchos tornillos y pernos. En su hoja de respuestas, haga un círculo a las letras que representan tornillos hexagonales o sea de cabeza plana con seis lados. (Pausa)

¿Escogió las letras--D, E, y I? Si las escogió su anotación es perfecta. Si se equivocó y escogió alguno que no es hexagonal, obsérvelos y trate de encontrar porque no son hexagonales.

PARA EL ESTUDIANTE

En este manual usted aprenderá a identificar los símbolos para las tres clases de válvulas usadas en plomería. Además usted aprenderá los símbolos para las tres maneras de unir tuberías.

Gracias por aprender estos símbolos. Haciéndolo, usted nos está ayudando a ser mejores maestros. Gracias también por hacer su mejor esfuerzo. Ahora vuelva la página al juego A o sea la válvula de globo.

Juego A

En la casilla A usted puede ver la ilustración de una válvula. Una válvula se ilustra como un par de líneas cruzadas.

En la casilla B, note que el círculo al centro de las líneas cruzadas es el símbolo de una válvula de globo.

En la casilla C, está ilustrada una válvula de globo o sea un círculo negro cruzado al centro por dos líneas.

La ilustracion para una valvula de globo en la casilla D tiene diferentes clases de terminaciones pero siempre la ilustración tendrá líneas cruzando el círculo negro como aparece en la parte superior de la casilla D.

El símbolo #1 en la casilla E representa una válvula de globo porque tiene líneas sólidas cruzando un círculo negro. La ilustración #2 no representa una válvula de globo porque no tiene el círculo negro en el centro de las líneas cruzadas.

La ilustración #1 en la casilla F no representa una válvula de globo porque no tiene un círculo grande en el centro de las líneas cruzadas. El número 2 es la ilustración du una válvula de globo porque tiene las líneas cruzadas con un círculo en el centro.

Ninguna de las válvulas ilustradas en la casilla G simboliza una válvula de globo, porque no tiene un círculo en el centro de las líneas cruzadas.

Las válvulas ilustradas en la casilla H representan válvulas de globo porque tienen las dos partes necesarias (1) dos líneas cruzadas y (2) un círculo en el centro de las líneas.

En la casilla I, se encuentran diferentes tipos de válvulas representadas.

Seleccione las válvulas que usted crea representan válvulas de globo. Escriba su respuesta en la hoja de papel provista para esto junto a las preguntas de la primera revisión. Por favor no escriba en este manual.

Las válvulas de globo son: C, D, E, I, y J. Si ud. marcó con un circuló las letras C, D, E, I, y J recibe un puntaje perfecto.

JUEGO B

En la casilla A, verá usted la ilustración de una válvula. Una válvula se ilustra como dos líneas cruzadas.

En la casilla B, notará que la S colocada al centro de las líneas cruzadas es el símbolo de una valvula de seguridad.

En la casilla C verá representada la válvula de seguridad, un juego de líneas cruzadas con una S en el centro.

La ilustración para una válvula de seguridad puede tener diferentes terminaciones como se ilustra en la parte inferior de la casilla D, pero siempre tendrá las líneas cruzadas y al centro una figura en forma de S en el centro donde se las líneas como se muestra en la parte superior de la casilla D.

La ilustración #1 en la casilla E no simboliza una válvula de seguridad porque no tiene la forma S en el centro. La ilustración #2 simboliza una válvula de seguridad porque tiene las líneas cruzadas y la forma S al centro.

La ilustración #1 en la casilla F representa una válvula de seguridad porque tiene la figura S en el centro. La ilustración #2 no representa una válvula de seguridad porque no tiene la figura S al centro.

Ninguna de las válvulas ilustradas en la casilla G representa una válvula de seguridad porque no tiene la figura S al centro.

Todas las válvulas representadas en la casilla H representan válvulas de seguridad porque tienen los dos partes necesarias, o sea (1) las líneas cruzadas y (2) la figura en forma de S al centro de las líneas.

En la casilla I, se encuentran representadas diferentes tipos de válvulas. Usted debe seleccionar las que representan válvulas de seguridad. Escriba su respuesta en la hoja provista para esto junto a la pregunta #2. Por favor no escriba en este manual.

Las respuestas correctas son: B, F, H, K, y M. ¿Marcó ud. con un círculo B, F, H, K, y M? Si lo hizo receibe ud. un puntaje perfecto.

JUEGO C

En la casilla A usted podrá ver simbolizada una válvula. Una válvula se representa como dos líneas cruzadas.

En la casilla B, observe como se representa una válvula de entrada, o sea dos líneas cruzadas al centro que no tiene figuras, como las anteriores.

La ilustración para una válvula de entrada pueden tener diferentes terminaciones como podrá ver en la casilla C, dos líneas cruzadas y nada al centro.

La ilustración en la casilla D representa una válvula de entrada porque contiene las líneas cruzadas con ninguna figura al centro. La ilustración #2 no representa una válvula de entrada porque tiene una figura al centro de las líneas.

La ilustración #1 en las casilla E tampoco representa una válvula de entrada porque tiene un círculo en el centro de las líneas cruzadas, la #2 representa una válvula de entrada porque tiene las líneas cruzadas y al centro no tiene figura.

Ninguna de las válvulas representadas en las casilla F representa una válvula de entrada porque cada símbolo tiene alguna figura en la unión de las líneas.

Las respuestas correctas son: A, G, L, N, y O. ¿Marcó ud. con un círculo A, G, L, N, y O? Si lo hizo recibe ud. un puntaje perfecto.

JUEGO D

En la casilla A usted puede ver el símbolo usado para representar una válvula. Una válvula se representa con dos líneas cruzadas.

En la casilla B usted puede observar como una clase particular de válvula se puede unir o fijar a una tubería, observe la terminación de la válvula representada. Existen cinco maneras diferentes de unir una tubería a una válvula. Queremos enseñarle los símbolos para las tres maneras de unir una válvula con una tubería.

En la casilla C, usted podrá ver como se representa una tubería que ha sido soldada con soldadura autogena. Este tipo de soldadura autogena se representa por medio de una "X" sobre la linea, que muestra donde la tubería ha sido unida a la válvula, piense en la "X" como representando las chispas que se producen cuando la tubería es soldada autogens.

Todos las tipos de válvulas pueden ser soldados autogena. En las casilla D, usted podrá ver que si una válvula va a ser soldada autogena a una tubería, la figura X (o figura de chispa) debe de encontrarse al final de la representación o figura.

La ilustración #1 en la casilla E tiene uniones que han sido sodadas con soldadura autogena porque la figura X ha sido colocada en las líneas al final del símbolo; #2 no ha sido soldada de esta manera porque no tiene la figura X al final; #3 tampoco ha sido soldada de esta manera porque no tiene la figura de una "X" en ninguno de los extremos.

La representación #1 en la casilla F tiene uniones que no han sido soldadas con soldadura autogena porque no tiene las figuras "X's" in las líneas extremas de la ilustración; la ilustración #2 no tiene uniones soldadas autogenas porque no tiene figuras "X's" en las líneas en los extremos de la ilustración; las uniones en la ilustración #3 han sido soldadas autogenas con este método porque tienen las figuras "X's" en las líneas a los extremos de la ilustración.

Ninguna de las uniones representadas en la casilla G han sido soldadas autogenas porque no tienen la figura "X" colocada en las líneas a los extremos de la ilustración. Todas las uniones para los simbólos de válvula en la casilla H han sido soldadas autogenas porque cada una de ellas tiene una figura "X" en las líneas en los extremos de la ilustración.

En la casilla I, seleccione los tipos de válvulas que han sido unidas a las tuberías por medio de soldadura autogena. Escriba su respuesta en las hoja de papel provista para esto en la revisión de la pregunta #4. Por favor no escriba en este manual.

Debe ud haber marcado con un círculo: B, F, G, y J. ¿Marcó ud. B, F, G, y J? Si lo hizo receibe un puntaje perfecto.

JUEGO E

En la casilla A usted podra ver representada una válvula. Una válvula se ilustra como dos líneas cruzadas.

En la casilla B usted observará como una clase de válvula ha sido unida o asegurada a un pedazo de tubería, mire los extremos de la ilustración.

Existen cinco diferentes maneras de unir una tubería con una válvula. En la casilla C, usted podrá ver representada una tubería que ha sido soldada por medio de la soldadura blanda, el simbolo usado para una soldadura blanda de este tipo es una figura en forma de "O" cruzando las lineas en los extremos de la válvula ilustrada. Usted deberá pensar que la figura "O" son las burbujas que se forman cuando la unión es soldada blanda. Todas las válvulas pueden ser soldadas blandas como se demuestra en las casilla D. Cuando una válvula va a ser soldada blanda a una tubería; el símbolo usado será un círculo "O" colocado en los extremos de la válvula ilustrada.

La ilustracion #1 en la casilla E tiene uniones que no han sido soldadas blandas porque el círculo "O" no ha sido colocado en las líneas a los extremos de la ilustración. La ilustración #2 tiene uniones que han sido soldadas blandas porque los círculos se encuentran en las líneas a los extremos. La ilustración #3 tiene uniones que no han sido soldadas blandas porque los círculos "O" no aparecen en las líneas a los extremos de la ilustración.

La ilustración #1 en la casilla F muestra uniones que han sido soldadas, blandas porque los círculos han sido colocados en las líneas en los extremos de la ilustración; la ilustración #2 no tiene uniones soldadas blandas porque no tiene círculos en las líneas a los extremos de la ilustración; la ilustración #3 tampoco tiene uniones soldadas blandas porque no tiene círculos en las lineas a los extremos de la ilustración.

Ninguna de las uniones ilustradas en la casilla G han sido soldadas blandas porque no tienen círculos colocados en las líneas a los extremos de la válvula ilustrada.

Todas las uniones en las válvulas ilustradas en la casilla H son uniones soldadas blandas por este método llamado blanda porque los círculos han sido colocados en las líneas a los extremos de la válvula ilustrada.

En la casilla, I, seleccione usted todas las válvulas que ilustran el sistema de union soldada por el método llamado blanda Escriba sus respuestas en la hoja de papel que se ha provisto junto a las pregunta #5. Por favor no escriba en este manual.

Las repuestas correctas son: A, H, I, y O. ¿Marcó ud. con un círculo A, H, I, y O? Si lo hizo recibe ud. un puntaje perfecto.

JUEGO F

En la casilla A observe la ilustración de una válvula. Una válvula se representa como dos líneas cruzadas.

En la casilla B observe un tipo de válvula que ha sido unida o fijada a un pedazo de tubería que entra en la válvula, note los extremos de la válvula ilustrada.

Hay cinco maneras de unir un pedazo de tubo a una válvula. En la casilla C, note la ilustración que se usa para representar un pedazo de tubería unido a una válvula por el método de roscas. En otras palabras, la tubería será enroscada a la abertura de la válvula. La ilustración que muestra que un pedazo de tubo ha sido unido a una válvula por el medio de roscas es una línea perpendicular a los extremos de la válvula. Cuando la unión es por medio del sistema de roscas, no se colocara ninguna figura de X o un círculo "O" en las líneas a los extremos de la válvula.

En la casilla D se ilustran diferentes tipos de válvulas unidas a la tubería por el método de roscas. La línea a los extremos de la válvula no muestra ni cruces ni círculos.

La ilustración #1 en la casilla E tiene uniones por el método de roscas, porque tiene una línea perpendicular a los extremos de la ilustración y no se observan cruces o círculos en esas líneas a los extremos de la válvula.

La ilustración #2 tiene uniones que no han sido enroscadas porque tiene líneas dobles (paralelas) en los extremos de la ilustración.

La ilustración #1 en las casilla F tiene uniones que no han usado el método de roscas. La cruz "X" en las líneas a los extremos de la ilustración, muestra que las uniones han sido soldadas por el método de soldadura autogena y no por el método de roscas. Las válvulas en la ilustración #2 han sido unidas por el método de roscas; las válvulas ilustradas en el #3 han sido unidas por medio del método de soldadura blanda, como lo demuestran los círculos en los extremos de la ilustración.

Ninguna de las ilustraciones en la casilla G muestran uniones hechas por el método de roscas. Todas las ilustraciones en la casilla H muestran tuberías unidas a válvulas por el método de roscas. Observe que no hay cruces o círculos a los extremos de la ilustración.

En la casilla I, seleccione las válvulas unidas a tuberías por medio del método de roscas. Escriba su respuesta en la hoja de papel provista para esto junto a la pregunta #6. Por favor no escriba en este manual.

Debe ud haber marcado con un círculo: E, H, J, y O. ¿Marcó ud. E, H, J, y O? Si lo hizo recibe ud. un puntaje perfecto.

JUEGO G

En la casilla A usted puede ver la ilustración de una válvula. Una válvula se ilustra por medio de dos líneas cruzadas.

En la casilla B observe un tipo de válvula unida o fijada a un pedazo de tubo, mire los extremos de la ilustración.

Al observar la ilustración de simbolos de plomería en la casilla C usted podrá identificar que tipo de válvula es esa. Además podrá identificar el método usado para unir la tubería con la válvula. Finalmente, la ilustración le dirá si la tubería es de agua fría o caliente.

En la casilla D, las dos flechas señalan la tubería que está unida a la válvula. Observando la línea representando a la tubería, podrá usted decir si es una tubería de agua fría o caliente.

En la casilla E se ilustra una tubería de agua fría. Observe que la línea está quebrada, o sea guión seguido de un punto.

En la casilla F, todas las válvulas están conectadas a tuberías de agua fría porque las líneas a los extremos están quebradas, o sea guión seguido de un punto.

En la casilla G, la ilustración de la válvula con el número 1 tiene una tubería de agua fría proque el guión está seguido de un punto. Recuerde que el símbolo usado para una tubería de agua fría es guion-punto, guion-punto, guion-punto (-.-.-.-.) La ilustración #2 no puede representar una tubería de agua fría porque tiene un guión sequido de dos puntos en lugar de uno.

Ninguna de las válvulas ilustradas en la casilla H muestran válvulas unidas a tuberías de agua fría porque ninguna de ellas tiene un guión seguido de un solo punto.

Todas las válvulas ilustradas en la casilla I mestran que están unidas a tuberías de agua fría porque las líneas están compuestas de un guión seguido de un solo punto.

En la casilla J, seleccione todas las válvulas que ilustran que están unidas a tuberías de agua fría. Escriba su respuesta en la hoja de papel que se ha provisto junto a la pregunta #.. Por favor no escriba en este manual.

Las respuestas correctas son: A, C, H, I, K, M, y N. ¿Marcó ud. con un círculo A, C, H, I, K, M, y N? Si lo hizo receibe ud. un puntaje perfecto.

JUEGO H

En la casilla A usted puede ver la ilustración de una válvula. Una válvula se representa por medio de dos líneas cruzadas.

En la casilla observará un tipo de válvula que está unida o fijada a la tubería; note los extremos de la ilustración.

Al observar este símbolo de plomería en la casilla C podemos decir que tipo de válvula se está usando. También podremos determinar como la tubería está unida a la válvula y finalmente, podremos determinar si la tubería es de agua fría o caliente.

En la casilla D, las dos flechas señalan la tubería que lleva a la válvula. Al observar las líneas en los extremos de la ilustración, podremos determinar si representan tuberías de agua fría o caliente.

En la casilla E una tubería de agua caliente se ilustra por una línea quebrada hecha de un guión (-) seguida por dos puntos (..).

En la casilla F, todas las válvulas están unidas a tuberías de agua caliente porque las líneas representando tuberías están formadas de un guión seguido de dos puntos (-..-..-..).

En la casilla G, la válvula ilustrada en el #1 tiene una tubería de agua caliente porque tiene un guión seguido de dos puntos. Recuerde usted que el símbolo para la tubería de agua caliente es guión-punto-punto, guión-punto-punto (-..-..-..).

La ilustración #2 por lo tanto no muestra una tubería de agua caliente en esa válvula porque tiene un guión seguido de un solo punto en lugar de dos.

Ninguna de las válvulas ilustradas en la casilla H son de agua caliente porque ninguna de las líneas estan formadas por un guión seguido de dos puntos.

En la ilustración I todas las líneas que llevan a las válvulas son de agua caliente porque las líneas están compuestas de un guión seguido de dos puntos.

En la casilla J, seleccione las válvulas que están unidas a tuberías de agua caliente. Escriba su respuesta en la hoja de papel provista junto a la pregunta #8. Por favor no escriba en este manual.

Debe ud. haber marcado B, D, E, F, G, J, L, y O. ¿Marcó ud. con un círculo B, D, E, F, G, J, L, y O? Si lo hizo recibe ud. un puntaje perfecto.

APPENDIX D

Discrimination Coefficients for Tests on Plumbing Symbols

1. Valve Test (Single Component Questions)
   English Version
2. Valve Test (Multiple Component Questions)
   English Version
3. Valve Test (Single Component Questions)
   Spanish Version
4. Valve Test (Multiple Component Questions)
   Spanish Version

Valve Test (Single Component Questions)
English Version

Discrimination Coefficients by Question Number

Question Number	Coefficient
1	0.500
2	1.000
3	0.500
4	1.000
5	1.000
6	0.500
7	-0.500
8	0.500
9	0.500
10	1.000
11	0.500
12	0.000
13	1.000
14	1.000
15	1.000
16	0.500
17	0.500
18	1.000
19	0.500
20	1.000
21	0.500
22	1.000
23	0.500
24	0.500
25	1.000
26	0.500
27	1.000
28	0.000
29	0.000
30	1.000
31	0.500
32	1.000
33	0.500
34	1.000
35	1.000
36	0.500
37	0.500
38	0.500
39	1.000
40	0.000

Valve Test (Multiple Component Questions)
English Version

Discrimination Coefficients by Question Number

Question Number	Coefficient
1	0.667
2	0.000
3	1.000
4	0.667
5	0.667
6	0.667
7	0.333
8	-0.333
9	0.667
10	1.000
11	1.000
12	0.000
13	0.333
14	0.333
15	1.000
16	0.333
17	0.333
18	1.000
19	0.000
20	0.667
21	0.000
22	0.333
23	0.667
24	0.333
25	0.000
26	0.333
27	0.333
28	0.667
29	0.333
30	0.000
31	0.333
32	0.333
33	0.000
34	0.333
35	0.000
36	0.333
37	0.667
38	0.000
39	0.333
40	0.000

Valve Test (Single Component Questions)
Spanish Version

Discrimination Coefficients by Question Number

Question Number	Coefficient
1	1.000
2	0.250
3	1.000
4	0.750
5	0.750
6	0.750
7	0.500
8	0.750
9	1.000
10	1.000
11	1.000
12	0.750
13	0.750
14	1.000
15	0.750
16	0.750
17	0.500
18	0.750
19	0.750
20	1.000
21	1.000
22	0.750
23	1.000
24	1.000
25	0.750
26	0.500
27	1.000
28	1.000
29	0.250
30	1.000
31	1.000
32	0.750
33	1.000
34	0.750
35	1.000
36	1.000
37	1.000
38	1.000
39	0.750
40	0.250

Valve Test (Multiple Component Questions)
Spanish Version

Discrimination Coefficients by Question Number

Question Number	Coefficient
1	0.200
2	0.600
3	0.400
4	0.600
5	0.800
6	0.800
7	0.400
8	0.800
9	1.000
10	0.800
11	0.600
12	0.600
13	0.600
14	0.400
15	0.600
16	1.000
17	0.600
18	0.600
19	1.000
20	0.800
21	1.000
22	0.600
23	0.800
24	1.000
25	0.800
26	0.000
27	0.800
28	0.600
29	0.800
30	0.800
31	1.000
32	1.000
33	1.000
34	0.800
35	0.800
36	1.000
37	1.000
38	0.600
39	0.800
40	0.800
41	1.000
42	0.800

APPENDIX E

Mini - Report on Vocational Concept Learning for Special Needs Students*

* Included in sleeve attached to back cover.